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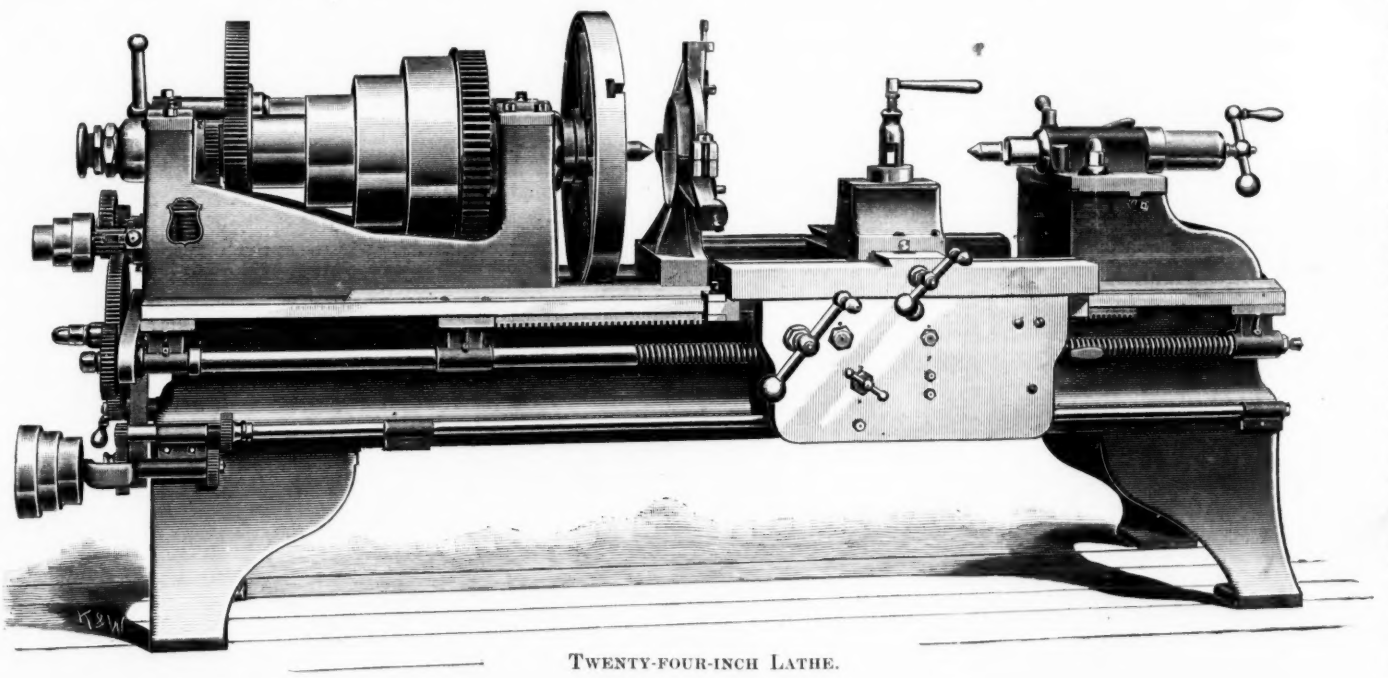
Twenty-four-inch Lathe.

The accompanying illustration is of 24″ lathe built by P. Blaisdell & Co., Worcester, Mass. The lathe swings 26¼″ over the bed and 16⅝″ over the carriage. The cone is 17″, 13½″, 10″ and 6½″ diameter, 4¼″ face. The large gear or spindle is 18½″ diameter, 2 diametral pitch. Back gear is proportioned 15 to 1 and things are so arranged that in changing from open belt to gears the change of speed is uniform. The front bearing is 4½″ diameter, 7″ long; back bearing 2⅝″ diameter and 5½″ long. Hole in spindle 1⅝″ diameter, if desired. The centers are made of the best crucible steel, size and taper of the Morse number 5 socket, and have a square section for removal by wrench. The spindle is of hammered cast crucible steel, about 60 points carbon.

The feed is driven by a rod with either belt or gears, and is so arranged that rates of feed can be had from 84 to the inch to 2 to the inch. The carriage has a bearing ⅞″ wide on Vs and 32″ long. Taper attachment or compound rest are furnished when required.

The lathe is furnished with friction countershaft center rest and full set of change gears to cut all threads from 2 to 12 and all even threads from 12 to 22.

The bearings and all sliding surfaces are scraped to fit. Weight with 12-foot bed is 5,400 pounds.



TWENTY-FOUR-INCH LATHE.

Boiler Capacity.

BY W. H. BOOTH.

Some few years ago, when engaged on electric traction work, I had occasion to notice how very slight appeared the hold of certain of the electricians upon the facts bearing on the power required to do their work, and was surprised to see when in committee how an artful witness in opposition had the cheek—for it was nothing else—to try to make out that where a momentary power of say 1,000 horse would be required to be developed, it would be necessary to provide boilers of 1,000 horse-power capacity, although the mean daily rate of work would not exceed say 500 horse-power. The fact that this witness either knew no better, or thought his opponents knew no better, was somewhat of a revelation to me, and considerably diminished the estimation in which I had held that witness up to his willful or ignorant misrepresentation; not but what I think it a good thing for every young engineer to be early cured of all reverence for reputed greatness, which he may some day find has no substantial foundation. This question of boiler capacity has, I find, great difficulties for many people who underrate the capacity for heat storage which lies dormant in a mass of water ready to spring into action, either as a giver out or an absorber upon change of pressure. In one thousand pounds of water a change in the superincumbent steam pressure of 5 pounds per square inch implies a difference of temperature of something like 5 degrees, or 5,000 heat units in an ordinary boiler per 1,000 pounds, and a large boiler may thus set free or absorb 150,000 heat units with a variation of 5 pounds pressure, or, roughly, enough to supply 150 pounds of steam from ordinary hot feed. Such a boiler serving say a 300 horse engine will ordinarily yield 6,000 pounds of steam per hour, we may assume, or 100 pounds per minute. The heat capacity of the water under a range of only one pound of pressure will therefore be sufficient to give $\frac{30}{100}$ of 300 horse power for one minute. In other words, an addition of 90 horse-power to the load upon the engine could be coped with by the boiler on a drop of one pound pressure for each minute during which the excess of load continued, and, per contra, a drop in the power of the engine would be taken up—stored in the water of the boiler—under similar small rise of pressure.

If we could imagine a boiler of such small water capacity that each stroke of the engine corresponded with a stroke of the feed pump, and the water thus supplied was at once evaporated, there being no other water in the boiler, we should have a condition of things where the furnace would require to be big enough to give always the maximum power, and, when smaller powers were called for, the heat of the furnace in excess would go to waste, for we could not make sudden demands upon a furnace to blow hot or cold instantaneously. We can do this, however, with the boiler, and it will instantly respond and yield more or less steam at call, and waste none at the safety valve, for it contains great powers of equalization within itself, and those boilers which least have this power are the worst to prime, and the most difficult to fire with satisfaction or economy. It follows, therefore, that for all work consisting of merely momentary fluctuations of the work to be done, there is no reason whatever for allowing a greater capacity of boiler than is necessary to deal with the water evaporation between the hours of starting and stoppage, as though evenly distributed over that period. Water capacity is as essential for a boiler as is a fly-wheel to an engine, and yet it is common to find electrical engineers, more especially who have to deal with large variations of load, arguing that they must have boilers of small water capacity, so that they may respond quickly to sudden demands. Now the fact is that no practical boiler can respond to such sudden calls for power as are made in traction work before the demand has ceased, and therefore can do nothing saving and except from its water-stored heat, and that it is fallacious to reduce water capacity with any such idea, for what is really needed is more water capacity.

When steam of higher pressure is used the drop of a pound in pressure corresponds with less than a degree of temperature, and therefore the capacity of equalization is less for similar variations in pressure, though perhaps not for similar percentage of variation, for with steam at 200 pounds, a drop of 10 pounds is of no greater significance than a drop of 5 pounds in the case of steam at 100 pounds. Sudden demands for power or sudden reductions are thus easily provided for by a good boiler, and it is not difficult to perceive the importance of proportioning boilers to do this. It follows, as a matter of course, that where an endeavor is made to provide large heating surface and small capacity, there is great probability of serious pressure fluctuation, and it equally follows that the smaller the heat storage capacity, the more nearly must the heating surface approach that necessary to give the maximum duty, as though such maximum continued all day, and when not at maximum duty steam will be made in excess, and therefore wasted. In all my experience I have found firemen work the hardest, grumble loudest and look dirtiest where the capacity bears the smallest ratio to the grate surface. There is incessant hauling at the dampers, blowing at safety valves, and struggling to keep pressure up or down. Everything is too lively, too quick; there is no steadiness, because there is no regulating force. With a uniformly steady load, these ill effects are less apparent, because of the less severe nature of the variation in the demand for steam.

A boiler of the size above referred to will have perhaps 300 cubic feet of steam space, and this will hold from 40 to 80 pounds weight of steam, according to pressure, which would supply two horse-power to four horse-power for an hour, or, as before figured, it would supply for one minute from 120 to 240 horse power if it could all be used; but it cannot. We can only utilize steam capacity by allowing the pressure to drop. A drop of 5 pounds would give from 3 to 3¼ pounds of steam for immediate use, or approximately one-sixth of a horse-power per hour, which is equal to 10 horse-power for a minute. It is evident, therefore, that in the boiler to which my figures refer, a drop of 5 pounds in pressure will liberate much more power from the water than from the steam, and that large steam capacity has been over-rated. It has, in fact, received the credit properly due to large capacity for water which usually accompanies large steam capacity. Anyhow, the water is the more important of the two, and this leads us to recognize the importance of a good circulation in a boiler, or otherwise there may be a bulk of comparatively cold water in places which, when disturbed, will produce a rapid and serious reduction of pressure.

The whole of the water in the boiler should be at one temperature as nearly as possible, so as to be in a position to act promptly as an equalizer of duty. Steam domes, held by some as so useful in adding to steam capacity, have very little value in that respect, and are not now much appreciated as an aid to steam dryness. They are now hardly ever added to stationary boilers in English practice, and better results are got from anti-priming pipes, in which the length is considerable, and the area of the perforations not above 25 per cent. in excess of the steam outlet area, so that steam is drawn from over a considerable area without that rush to any one spot which occurs with the dome or other direct outlets.

Arguments of all kinds may be used in favor of quick-steaming boilers, but the success of large cylindrical boilers in both this country and America, though the details and general arrangements are so different, point strongly to the capacity for water as

the reason of their success, and I have observed lately a tendency in other types of boilers to come into line on the water question by increasing some dimension or adding some detail which secures this prime factor of success.

All arguments against water are equally weighty against fly-wheels. One very powerful argument is that when a boiler of large water capacity bursts, it is more destructive than one of small capacity. This to me is a strong argument in favor of the capacious boiler, and it is just as true of heavy fly-wheels, which are liable to burst, as did that at Amoskeag Mills, and for the same reason that boilers burst—bad material or design. With a boiler the question of safety is simplicity itself, and involves the use of good material in sufficient quantity, put into the proper place, and suitable attendance to look after well-designed fittings at a suitable remuneration.

The failure of the switchmen's strike at Buffalo should teach railroad men that they can no longer hope to win in a strike against a railroad corporation. There may be other means—there undoubtedly are other means—to compass honest ends; these means railroad men will be wise if they discover, abandoning the strike as impracticable.

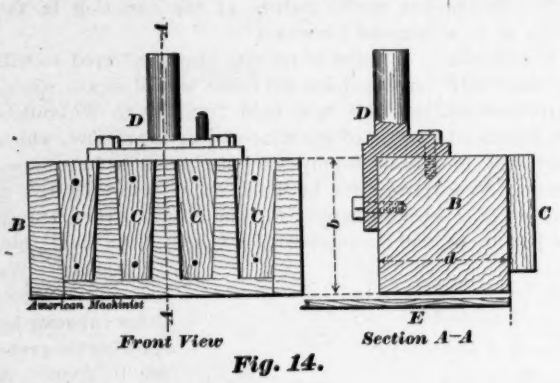


Fig. 14.

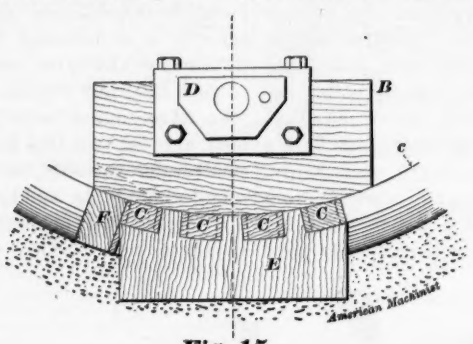


Fig. 15.

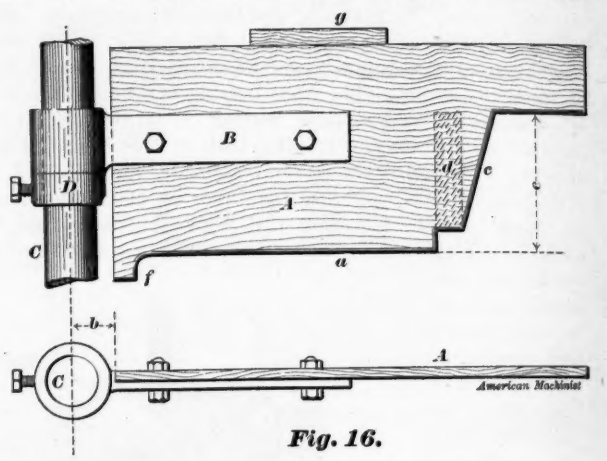


Fig. 16.

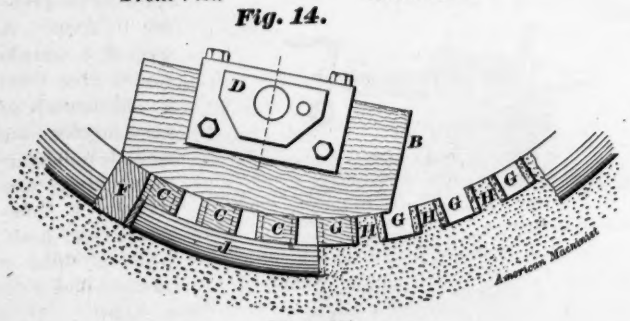


Fig. 17.

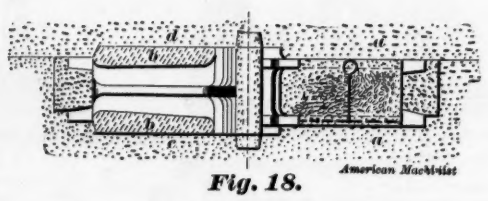


Fig. 18.

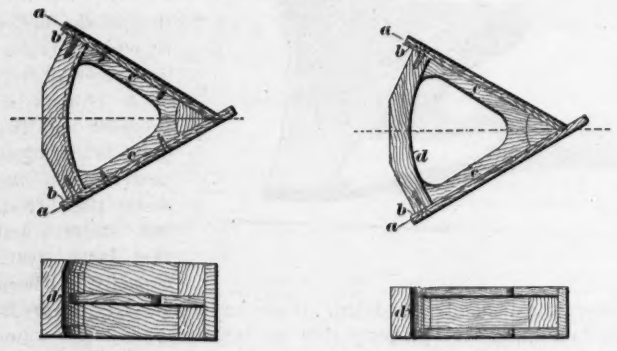


Fig. 22.

Fig. 21.

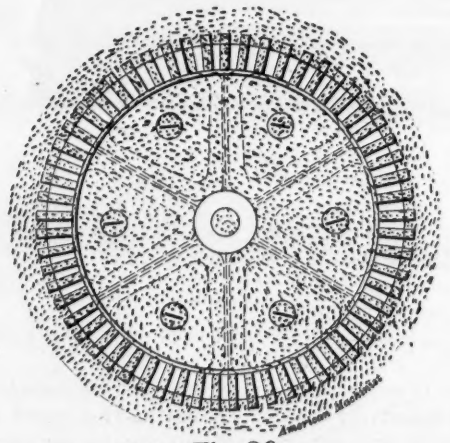


Fig. 20.

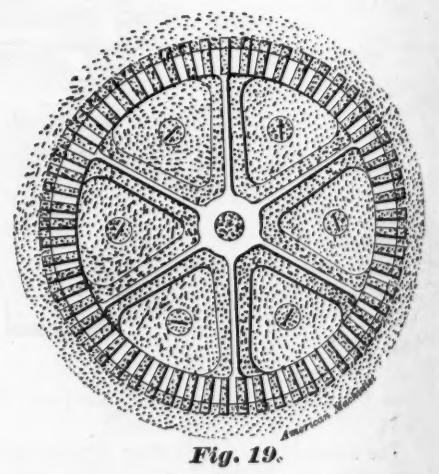


Fig. 19.

COGGING WHEELS.

Cogging Wheels—III.

BY JOSEPH HORNER.

I will now take the case of mortise wheels made by molding machine. The pattern work for this is of a special character, and work in which I have been in constant touch since the introduction of the wheel machines. The spur wheels will form the subject of the present paper, the bevels of the next. Figs. 14 and 15 illustrate a segmental block for a spur mortise. The block *B* is of the same depth *b* as the wheel rim, and the radius *c*, of its face, is the same as that of the wheel. But the width *d* is a matter of no moment, because the whole of the interior of the wheel is formed with cores. Prints *C* are fastened upon the block, and, except in the number required, they differ in no respect from those put upon a complete pattern. The number put upon the block is, within moderate limits, arbitrary. There may be two, three, four, or even six. From three to four are generally used. There is an advantage in having three or four prints, because then two or three spaces can be rammed at once without lifting and slewing the block, whereas with two prints only a single space can be rammed at each setting. But if more than two prints are made use of, great care must be taken to pitch them all alike.

Before the block is set, a bed is struck in the foundry floor or in a flask, by means of a striking board *A*, Fig 16. The board is attached to a special strap *B*, belonging to the machine. The distance *b* from the center to the shoulder being constant, the pattern maker squares the board *A* off to the radius of the wheel, minus that distance *b*. The strap slides upon a turned pillar *C*, and is set at any required height by means of the collar *D* with set-screw. The edge *a* of the board strikes a level bed, and the edge *c* a sloping wall of sand, which is afterwards to be filled up when ramming the print spaces; the shaded part *d* represents the print section, and the depth *e* equals the depth *b* of the block in Fig. 1; *g* is a spirit level used for checking the horizontal accuracy of the board, for which purpose the top and bottom edges of the board are made parallel. The striking edges are chamfered in the usual manner.

When the bed has been struck, the block *B*, in Figs. 14 and 15, set to correct radius by means of a strip *E*, reaching from the circumference to the central pillar of the machine, is lowered by the carrier *D* upon the bed which has been struck with the edge *a* of the board in Fig. 3; the spaces between the prints *C C C C* and their front edges are then rammed with sand out to the sloping wall struck with the edge *C* of the board. A block *F* is held at the extreme left to prevent the sand from tumbling down there. Three or four nails are rammed in, and vents carried out diagonally. Then the block has to be lifted, to prevent the sand from being pulled up. A "finger bit," or "hold-down piece" *E*, in Fig. 15, of about ¼" thickness, cut to fit just within the print, is held down upon the sand while the block is being lifted.

The block is now slewed round into the next position, and lowered for re-ramming. Fig. 17 shows it in this position. *G, G, G* are the three print impressions just made, and the last print on the block fits down into the last print impression. *H, H, H* are the outer spaces of sand. The space *J* is now waiting to be filled in and rammed similarly as in Fig. 15. These operations are continued until the wheel rim is completed.

The interior portions of machine-molded wheels are always formed with cores—usually made in dried sand. In my first paper I illustrated a pattern wheel made with + arms. In machine-made molds it is usual—because more convenient—to make arms of *H* section. I illustrate both of these methods in these figures. Fig. 18 shows on the right hand a half vertical section through a cored-up mold, formed with cores for arms of *H* section; and on the left hand a half vertical section, formed with cores for + arms. Fig. 19 illustrates a cored-up mold in plan for *H* arms; Fig. 20 one for + arms; Fig. 21 shows the core box for *H* arms; Fig. 22 that for cross-arms. I need not enter into very much descriptive detail, as the illustrations are, to a large extent, self-explanatory.

Comparing the figures, it is seen that the arms of *H* section, Fig. 18, are plain, *a a* on top and bottom. Such being the case, a level bottom bed and level cope only are required. But the arms of + section are dished, *b b* at top and bottom, and therefore the bed and cope must be dished correspondingly, and the core box also dished; or else the cores must be made to abut over the edges of the arms, as shown in Fig. 20, and be made, therefore, of somewhat greater depth than the arms; and a recessed bed *c* and recessed cope *d*, Fig. 18, must be also struck to match the cores. One of these things must be done, unless, indeed, the ribs are carried along straight and level with the rim of the wheel. I mention these alternatives because they frequently occur in practice. There is an advantage in having cores that do not abut over the edges of ribs. If they abut, as in Fig. 20, they cannot be adjusted to compensate for the least inaccuracy. But if made, as in Fig. 19, with open spaces, corresponding with the arm thickness, they will admit of a little adjustment inwards or outwards, to compensate for slight inaccuracies in pattern work or in core making.

The sections in Fig. 18 show one arm core and one mortise core in place. The section to the left is taken across the joint face of a + arm core; that to the right through the middle of an *H* arm core, showing the inclosed grid and cinders. The eyes of the grids are seen in Figs. 18 and 19.

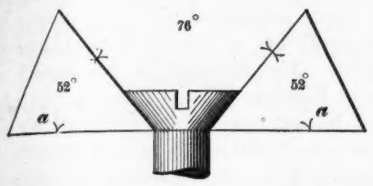
In the core boxes in Figs. 21 and 22 the dotted lines *a a* represent center lines corresponding with the sixth part of the wheel; *b b* are the inner faces of the vertical arms, so that the distance from *a* to *b* represents just one-half the thickness of the vertical ribs; and the distance *C* from the center lines to the inner edges of the flat arms is equal to just half the width of those flat arms. The edge *d* of the sweeped piece corresponds with the inner face of the wheel rim. This is screwed to the radial sides of the core box during ramming, and is unscrewed before the core can be removed. The arms also are taken out from the core in separate pieces.

The Angle of Countersunk Head Machine Screws.

It will be remembered that in our issue of July 28 we had something to say about a standard angle for the heads of countersunk machine screws, and published letters from a few of the most prominent producers of such screws, these letters showing that there was no standard angle. We have since then received a letter on this subject from the Brown & Sharpe Manufacturing Company, in which they say:

"Inclosed herewith we hand you a small blue-print showing the angle of the head of our countersunk head machine screws. This blue-print represents exactly the drawing made in 1856, when this angle, 76 degrees, was adopted by Mr. Jos. R. Brown as our standard, after conference with some of the leading screw makers of that day. A gauge was made at that time by J. R. Brown & Sharpe, the name of the firm under which our business was then transacted, for the New England Screw Company, and we are informed that this gauge is still in use in connection with some of the products of the company which succeeded to the business of the New England. We have found the angle satisfactory for our own work, and are inclined to think that it would be equally satisfactory for general use. This opinion is confirmed by that of the president of one of the largest screw manufacturing companies in the country."

We have also had some conversation on this subject with a tool maker who was in a position to know something of the history of the development of screw making in this country, and have made inquiries in other directions, from which we learn that the several companies which were absorbed by the American Screw Company had each its own standard for the angle of the head, some of these being intended originally, no doubt, to agree with others, but varying on account of the comparatively imperfect methods of reproducing measurements, and of maintaining standards then in use. The trade built up by these companies demanded screws exactly like those previously furnished, and it was therefore difficult, if not



impossible, to change in any particular, even though a change might be best for all concerned eventually—a difficulty, too, which, of course, has increased with the growth of the business.

The letter of the A. S. Co, published in our issue named above, indicated that there were a number of different angles used by the company, because it speaks of a "list" of such angles.

It is to be regretted that there is no uniformity in this matter, and we do not know that anything can be done to secure it, unless manufacturers can agree upon something, which seems unlikely. It occurs to us, however, that for machine shops a standard might be established, and as the angles given by the engraving above are those of a gauge which was adopted after considerably study of the matter, and has been and is still extensively used, it would seem to be a good plan to conform to them, and, so far as possible in machine shops at least, make all such screws, and order those purchased to conform to it.

Fourteen-inch Engine Lathe.

We present herewith an illustration of an engine lathe of 14" swing and six-foot bed, built by Dietz, Gang & Co., of Cincinnati, Ohio. The engraving shows that the lathe follows substantially the modern standard form, but dispenses with tumbler and feed gears within the head, the gears and upper feed cone, usually carried on the stud, being placed directly on the spindle, and the feed reversed in the apron.

The spindle is of steel with a main bearing 2"x3¾", and has a ¾" hole through it, the taper of the center being No. 3 Morse. The spindle boxes are of phosphor bronze.

The carriage is furnished with plain, rise and fall, or, compound rest, as desired, and has automatic cross-feed. Foot-stock is of approved form, with eccentric clamp.

Though called a 14" lathe, it swings over the Vs 15½", and over the compound rest 10". With 6-foot bed it takes between centers 38". Gears are furnished for cutting threads from 4 to 40 per inch, including 11½ pipe thread. Weight, 1,400 pounds.

Referring to our recent remarks anent the workman's holiday, and the expense of it, Mr. John M. Parsons, a machinist living at 258 King street, London, Ont., Canada, writes that that place is the ideal one for a rational holiday making for a mechanic and his family. He offers to furnish to those desiring it, full information regarding the place and its advantages.

Railroading in Costa Rica.

A railroad man writing from Costa Rica says: There is a main line here 117 miles long and a branch 20 miles long, all narrow gauge. The railroad is owned by English capitalists and operated by English rolling stock in the most miserable condition that could be imagined. They have twelve or thirteen English locomotives that are the most awkward and badly proportioned engines I have ever seen. About half the weight of some of them is on the forward truck, and they all have stationary grates set lengthwise of the fire box, the same as in our old wood-burning locomotives. They go puffing up the mountain for two or three miles with a big Jamaica negro poking at the furnace every few minutes. Then they stall for want of steam and start the blower and injector. They never put water in the boiler when the engine is working. Sometimes this stop consumes half an hour. They have to stop about every fifteen or twenty miles to clean the fire, and this is done by pulling up some of the grate bars and knocking the dirt through.

No running is done with freight trains after night. There are only three stations on the main line between Limon and San José. It is a miserable country for a white man to live in, and I advise all your readers to keep away from it.—*Locomotive Engineering.*

A correspondent puts the matter in this way:

No brains had he got, nor tools, nor what not, and he looked confoundedly worried as he bolted away after spoiling his job, and out of the shop door he hurried.

A Study of Fly-wheels—II.

BY LEICESTER ALLEN.

The mean velocity, calculated for any point in the line of mean velocity for the mass of the rim, is taken as the basis of the percentage of variation of velocity, because, when the number of turns the fly-wheel makes per minute, or is required to make per minute, is known, and the diameter, measured on the line of mean velocity for the mass of the rim, is also known, this mean velocity can be very readily determined. In some cases, as that of a reciprocating steam engine working expansively and performing work either against a constant or a variable resistance, a fly-wheel, during a single revolution, may have more than one period of maximum or minimum velocity, and the calculations for variations of velocity must be made for these periods. As the action of such an engine is generally symmetrical for each of the forward and backward strokes of the piston, that is to say, whatever fluctuations of velocity occur during the forward stroke also occur on the backward stroke and at the same points of the stroke, the calculation for either of these strokes suffices for the other.

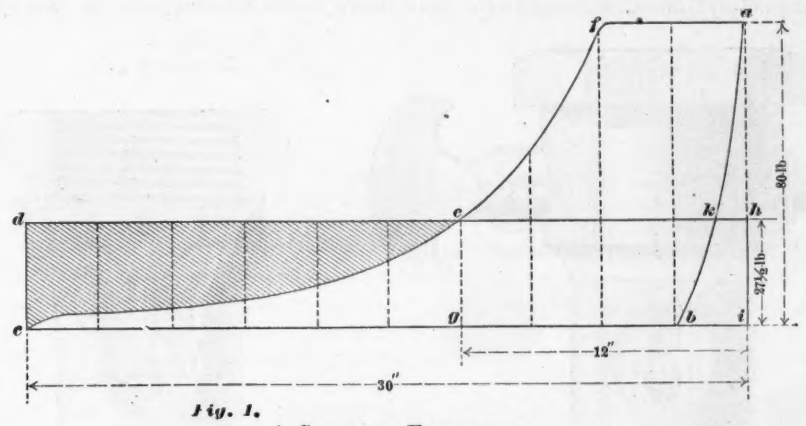


Fig. 1.

A STUDY OF FLY-WHEELS.

Let us first consider a case in which a steam engine working expansively operates against a uniform resistance, including useful work and frictional work, applied to the crank-pin in the same way as the driving power is applied, under the supposition that the friction of the engine itself under load is ten per cent. of its indicated power. In this case there will be a maximum and minimum velocity of the fly-wheel during each piston stroke or during each semi-revolution, and the points of the stroke at which these events occur can be determined.

An example of this case would be a water pump working against a constant head and driven by a crank and pitman of the same length as those of the steam engine, the cranks being set together or opposite to each other.

Knowing the constant resistance, which, as stated above, includes the frictional resistances both of the useful work done and of the motive power, we can proceed by the following method, not only to find the weight of the rim that shall permit only a given percentage of variation of velocity, but also to determine the exact points of the stroke at which the fly-wheel will have a maximum and minimum velocity; in short, we can make a complete analysis of the action of a fly-wheel under any set of conditions.

The method, so far as I know, has never, in all its features, yet appeared in print; but I have used it successfully for extremely complicated sets of conditions; for example, when three engines, cutting off early in the stroke, applied their power at different angles to a shaft that by a fourth crank drove an air compressor.

The method has the advantage that it involves only ordinary arithmetical computation, and entirely dispenses with trigonometrical and algebraic formulæ. One must, however, be able to construct to scale a diagram of pressures and volumes of steam inducted at any given initial pressure, and cut off at any point of the stroke.

To do this accurately will require familiarity with the use of logarithms. Or it may be that an indicator diagram taken from a steam cylinder of the same dimensions working under the same conditions of pressure and cut-off can be made available.

Having found the uniform resistance of the useful work to be performed, whatever it may be (let us assume it to be 4,320 pounds), and from the nature of the work having determined the percentage of friction involved in its performance (which we will assume to be twelve per cent.), let us investigate the case of a fly-wheel attached to an engine having a stroke of thirty inches, making or designed to make one hundred revolutions per minute, taking steam at eighty pounds gauge pressure, and cutting off at one-fifth stroke.

Adding to the resistance of the useful work twelve per cent. for frictional resistance we get $4,320 + 518.4 = 4\,838.4$ pounds. Our steam engine must, therefore, overcome this resistance plus the friction of the engine under load. As the engine friction has been assumed in this case as ten per cent., it follows that 4,838.4 pounds is ninety per cent. of the total resistance, or of the total mean effective piston pressure which the engine will be required to exert. Hence

$$4{,}838.4 \times \frac{100}{90} = 5{,}376 \text{ pounds},$$

which must be the total mean effective pressure on the piston. From this we can calculate the diameter of the piston and the work in foot-pounds.

Having drawn a diagram, *a b c e f*, Fig. 1, representing the volumes and pressures of steam inducted at eighty pounds pressure, and cut off at one-fifth stroke in a well-insulated cylinder, we find the mean effective pressure to be 27½ pounds; the scale for the stroke line *c i* being ⅛" = 1", and the scale for the pressure line *a i* being 1" = 50 pounds. The work performed by each square inch of piston area at each stroke will be $27.5 \times 2.5 = 68.75$ foot-pounds.

The total uniform resistance being 5,376 pounds, the work to be done by each stroke will be this resistance multiplied by the length of stroke in feet, or $5{,}376 \times 2\,5 = 13{,}440$ foot-pounds.

Finally, the total work performed by the piston, divided by the work performed by each square inch of piston area, will give us the piston area. It is

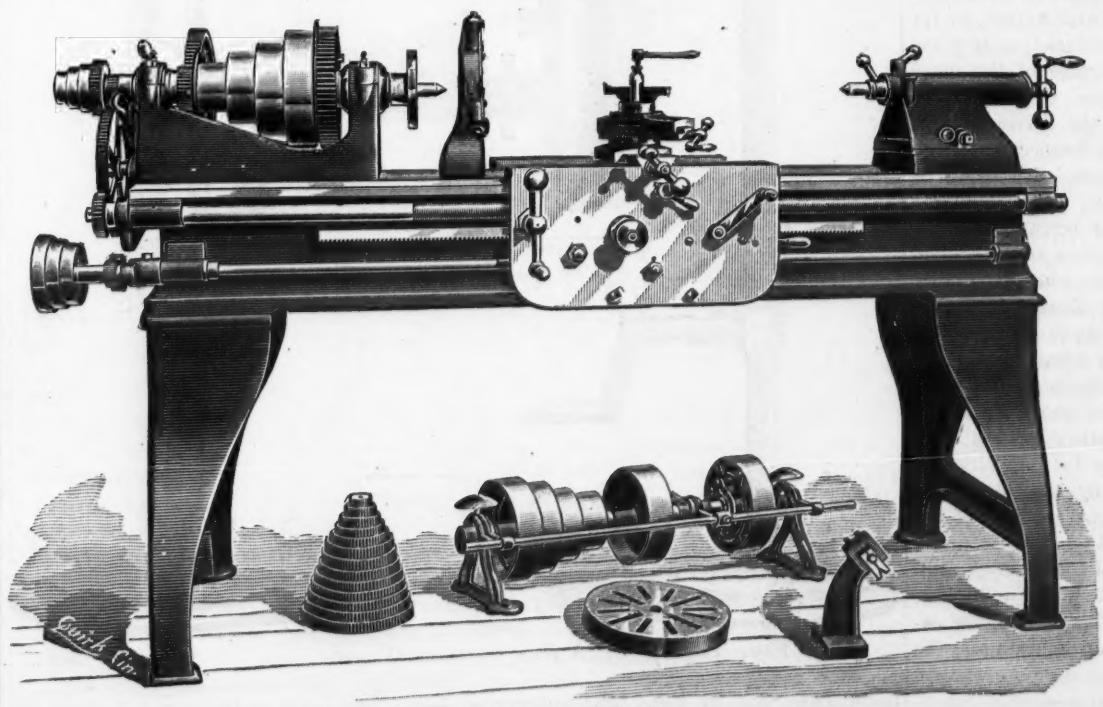
$$\frac{13.440}{68.75} = 195.59 \text{ sq. inches.}$$

The diameter corresponding to this is 15.78 inches.

As a diameter of 15¾ inches gives only a very slightly less area, and one of 15¼ inches gives an area of 197.9 inches, one of these diameters would probably be adopted by engineers as the most convenient. The slight power thus gained for the engine, or lost, will not materially affect our calculation for the weight of fly-wheel for which we have now acquired the data.

We assume one per cent. of the mean velocity as the limit of variation that can be permitted, and ten feet measured on the line of mean velocity in the rim as the largest diameter that is practicable in our case.

By making the radial dimension of the rim as small as practicable, that is to say by making the rim thin in proportion to its



FOURTEEN-INCH ENGINE LATHE.

width, we can increase the diameter of the line of mean velocity of the mass without correspondingly increasing the total diameter of the wheel.

The diameter of our wheel being ten feet on the line of mean velocity of the mass of the rim, the circumference corresponding to this diameter will be 31.416 feet. As the wheel is to make one hundred turns per minute, the mean velocity of any point in this circumference will be

$$\frac{100 \times 31.416}{60} = 52.36 \text{ feet.}$$

We have limited the variation to one per cent. of this velocity, or 0.5236 foot; and as this variation comprises an acceleration above the mean velocity and an equal retardation below it, we have $52.36 + 0.2618 = 52.622$ as the maximum velocity, expressed as accurately as is possible with three places of decimals, and 52.098 as the minimum velocity.

Now increase of velocity will take place at all parts of the stroke in which the total steam pressure exceeds the uniform total resistance, and decrease of velocity will occur in all parts of the stroke wherein the total resistance exceeds the total steam pressure.

In the diagram it is shown that the total steam pressure exceeds the total resistance during the part *i g* of the stroke and to a point a little beyond *e* of the expansion line, or through 12¼ inches of the stroke. During the remainder of the stroke the total resistance exceeds the total steam pressure, and the shaded part of the diagram indicates the excess of the resistance against one square inch of the piston, over the steam pressure upon a square inch. If, then, we find the mean pressure indicated by the shaded part of the diagram *c d e*, and multiply this pressure by the area of the piston = 195.59 square inches, then multiply the product so found by 17¾ inches, the part of the stroke through which retardation occurs, and lastly, divide the resulting product by 12, we shall have the work of the retardation in foot-pounds.

The mean pressure in this shaded part as computed from the average length of ordinates, in the usual manner of working up steam indicator diagrams, is 18 pounds. This multiplied by 195.36 gives 3,520.6 pounds. And $\frac{3,520.6 \times 17.75}{12} = 5,207.5$ foot-pounds.

We can now apply our rule given near the end of the previous article.

$$\frac{5,207.5 \times .64}{(52.622)^2 - (52.098)^2} = \text{weight}$$

of rim that will fulfill the required conditions. Performing the indicated operations we get 6,071 pounds, which weight, at the given speed, will limit the variation of velocity to the specified percentage of the mean velocity.

The case wherein both the driving power and resistance vary, the resistance increasing while the power decreases, remains to be considered.

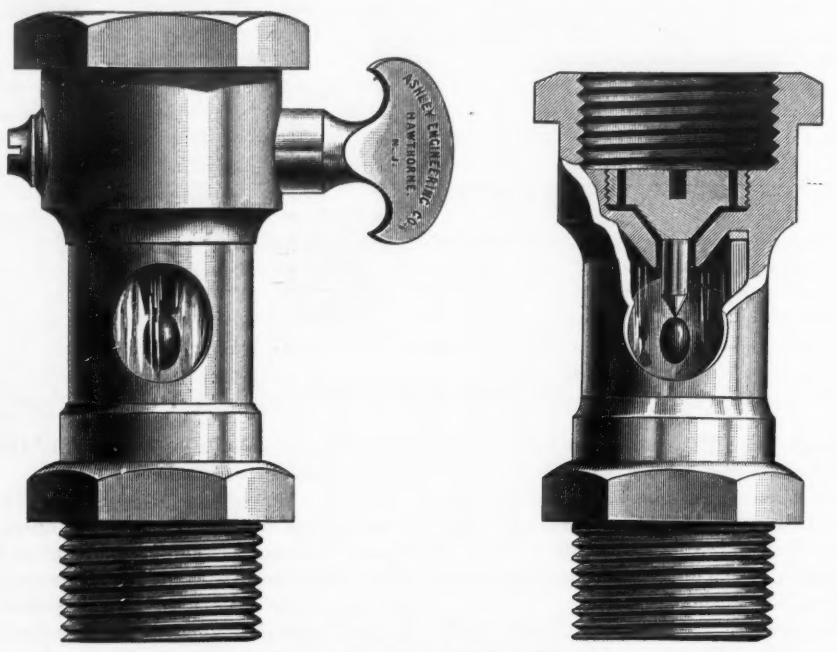
Rules and formulæ for constructing diagrams representing pressures and the corresponding volumes of steam when expanding are given in treatises on thermo-dynamics. The diagram *a b c e f*, in the figure, however, has been reproduced from a tracing of an indicator diagram taken from an engine working under the conditions above specified. The expansion line from *e* to *c* appears to be higher than it should be for adiabatic expansion as determined by the theoretical formula. For computing the weight of flywheels the formula would be more accurate, as, owing to various well-known causes, radiation from the walls of steam cylinders, valve leakage, piston leakage, etc., the expansion line of an indicator diagram may be sometimes misleading.

Railway and telegraph service should be made subject to army discipline.—*Evening Post.*

It hardly seems necessary to say a word in comment upon the above. What would apply to "railway and telegraph service" would equally well apply to domestic service, the shoveling of gravel and the like. All these, as things are done, come under the general head of work and wages. It is rather funny, after all, to contemplate where the whole thing would end.

Sight Feeds for Oil Cups.

We illustrate herewith a sight feed for oil cups, which is so arranged that it can be attached to the bearings of machinery it is desired to lubricate. It is arranged with an external thread at the bottom and an internal thread at the top, the former screwing in the bearing cap, and the oil cup screwing into the top. They are made in all sizes, and by their use any old-style oil cup is changed into a first-class sight-feed cup, the amount of oil fed being adjusted by the valves shown in the cup, and can be instantly shut off entirely when the machine is stopped. The oil is fed in drops, and thereby avoids any danger of the bearings running dry or of feeding more oil than is necessary, thereby wasting it, as the engineer or attendant can see at a glance whether or not the oil is being fed properly by looking in the glass. Being made in the form of an attachment, engineers having the large old-style oil cups do not have to throw them away, but by using this attachment can convert them into very efficient sight-feed cups. They are made of brass and finished in the best manner, by the Ashley Engineering Co., No. 136 Liberty st., New York City.



SIGHT FEEDS FOR OIL CUPS.

A New Surface Gauge.

The accompanying illustration is of a surface gauge, which, as will be seen, possesses some novel features. The stem is graduated, these graduations being read by the thin lower edge of the sliding head which carries the stud upon which the scriber or needle is fixed. This sliding head is in two principal parts, the lower portion carrying the needle being a neat sliding fit upon the stem, prevented from turning thereon by the spring pin shown in the sectional view, which engages with a V groove formed in the stem. The upper portion of the head is also prevented from turning upon the stem by similar means, its upper end being split and made conical, as shown, so that it is clamped to the stem by the knurled nut shown at the top of the head.

To the lower part of this portion of the head is threaded the adjusting nut, the lower part of which is enlarged to fit tightly over a ring of steel which is sprung into a groove turned in the lower portion of the head. Thus a very nice and neat adjustment is secured for the needle.

The scriber shown in Fig. 1 has a tubular shank, which fits snugly over the stud in the sliding head, and its marking point is just one inch from the center line of this stud. As the initial graduation on the stem is 1″ from the bottom surface of the gauge, the scribing point comes even with this surface when set to zero and in the position shown, while it is just 2″ higher when turned upon the stud to the position shown by the dotted lines; suitable marks indicating when the proper positions are secured. The lower edge of the scriber being straight and parallel to the center line of the stud, which is at right angles to the stem, the end can be ground off at the angle shown, to sharpen it as it becomes dull, without altering its height.

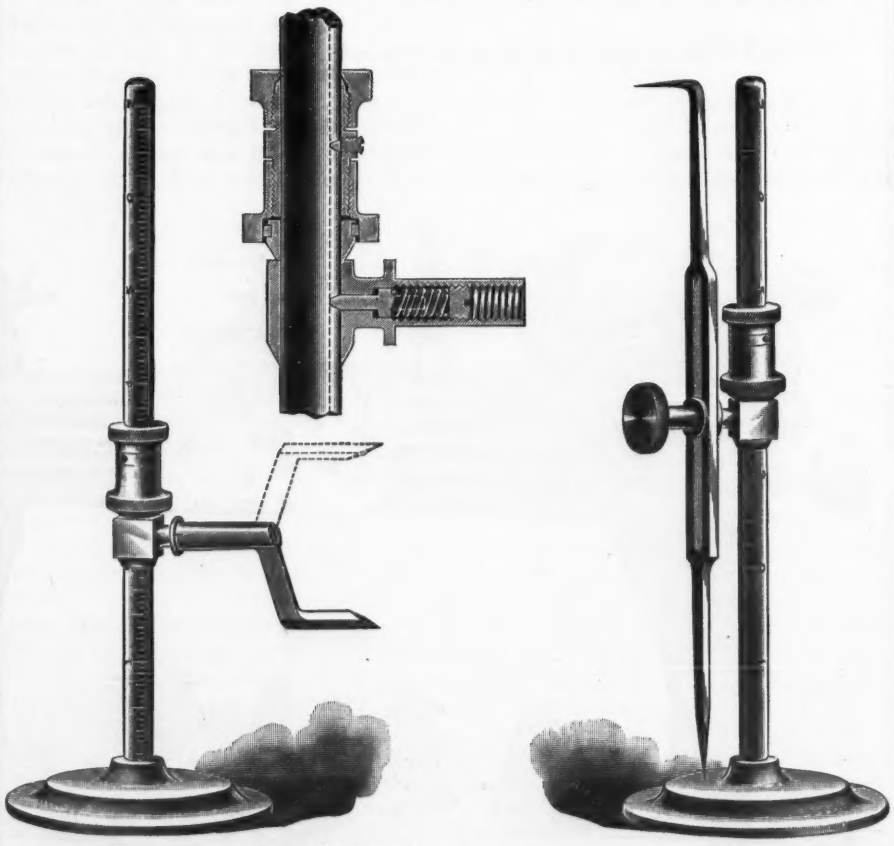


Fig. 1. A NEW SURFACE GAUGE. *Fig. 2.*

Fig. 2 shows the gauge with the ordinary form of needle on it, for which the stud is, of course, readily adapted, by fitting a screw into the thread at the outer end and providing suitable clamping collars and washers.

The gauge has been recently patented by Mr. Alfons Mauser, 54 Buckingham street, Hartford, Conn.

Rhode Island Inventors.

During the past hundred years the inventors of Rhode Island have contributed largely to the present perfection of the machinery used in modern shops and mills. Some of them have more than a State or a national reputation, and the value of their inventions has been recognized wherever power has been applied to machinery, both at home and abroad. The inventor of the slide lathe, Daniel Wilkinson, was a Rhode Island man, who, having made nothing out of his universally-used device, was paid $10,000 by Congress a few years before his death because the government had adopted the mechanism for its shops. The inventor of the braiding machine was a native of this State, and, like Wilkinson, he lived to see others accumulate fortunes by manufacturing the machine of his invention. The builder of the first successful power loom introduced into Rhode Island mills was paid $1,500 for the machine that was invaluable to cotton manufacturers, and enabled them to increase production to an incalculable extent. There are others whose names are not familiar to the public, although their inventions, without material alterations, have been universally employed upward of seventy years. One of these is Aza Arnold, a pioneer manufacturer of Rhode Island and an inventor whose name was perhaps more prominent than that of any other man interested in cotton-mills fifty years ago.

Aza Arnold was the son of Benjamin Arnold, one of the Providence County family of that name, and Isabella, daughter of Paul Greene, of Potowomut Neck. He was born at Pawtucket in 1789, and learned the carpenter's trade with John Smith, of Wickford, but afterward was a machinist, and in 1812 operated the Butterfly Factory in company with George Smith, who was his uncle by marriage. Their business was making woolen blankets. At this time he invented the "endless roving" for carding machines. Previous to this all roving was made by the carding machine in short rolls, which had to be pieced together in spinning. Fifty or sixty years ago there were scattered over the country, wherever there was a one-horse water-power, carding machines that worked up the farmers' wool into these short rolls of roving, to be spun into yarn on the farmer's hand-spinning machine. At this date, 1812, owing to the war with England, it was impossible to import files, and he invented a machine for cutting them, upon which files were made for their own use and for sale; but it was dropped at the close of the war, when it became possible to import them again. In 1818 he invented the "compound motion," or, as he called it, the "differential motion" mechanism for compounding two different motions or rates of speed to produce a third rate that should be the constant differential of the two, however much they might change or differ.

This was, as Zerah Colburn, the great arithmetician, expressed it, solving by mechanism an arithmetical problem that could not be solved by figures because of their running into series of circulating decimals. This motion he applied to the speeder, a machine used to prepare cotton roving for spinning, and patented it in 1823. Its value was quickly appreciated, as it enabled the manufacturer to turn off three skeins where he formerly had two, and the quality of the products was improved almost in the same ratio. It was testified in court by prominent manufacturers that it was worth to them $5 per spindle per annum. It was quickly adopted, and some Rhode Island manufacturers paid a royalty, but the Lowell and the Fall River companies refused, and suits were brought against them. After years of delay to send agents abroad to find if the invention was not

previously known there, the cases came to trial. The objection of the opposition was that a negative expression in one part of the specification was not repeated in another part, and Judge Story said to the counsel for the defense: "If that is your only objection, Mr. Arnold can surrender his patent and have that corrected, and come back here in two weeks ready to go on with the trial."

Accordingly he surrendered his patent, but instead of receiving it back in two weeks it was held in the Patent Office for months, and in the meantime the whole code of patent laws, known as the code of 1793, was repealed, and the new code of 1836 was passed, so that when his patent was returned it was under the new law; and having no patent under the old law, he was cut off from entering suits for infringements under that law. He did not know the cause of this fatal detention of his patent in the office until the latter part of his life. When he was a solicitor of patents in Washington he found in the archives of the Patent Office a letter from the leading counsel for the defense in his case to the Commissioner of Patents, saying, "Hold on to that patent till you hear from me," referring to his surrendered patent. This, which he had never suspected, fully explained to him how he had been defeated in his suit by the chicanery of the lawyers.

Benjamin Arnold, of East Greenwich, one of the sons of Mr. Aza Arnold, is one of the best known of living Rhode Island inventors. He was born in Pawtucket in 1822, and was educated at the private school of Joseph Henley—who will be remembered by some of the old residents of the Blackstone Valley—and at the Friends' School in Providence and the Friends' Select School of Philadelphia. An inclination for mechanics was developed in early life, and when twelve years old he made his first and last attempt to construct a perpetual motion machine.

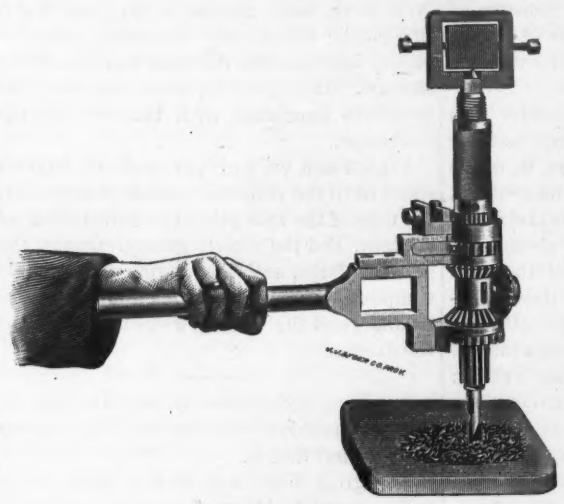
Among his many inventions is a new system of gearing—which is in extensive use in many different forms—for gaining power at the expense of speed. This consists of an external gear wheel having a greater internal gear wheel having a greater number of teeth, the inner wheel being placed on an eccentric on the shaft, so as to engage its teeth with those of the outer gear at one side, when the shaft and eccentric revolved, one of the gear wheels being held fast and the motion taken from the other. The gain in power and reduction in speed is in inverse ratio to the difference in the number of teeth in the two wheels. This was invented and patented in 1849, and has been successfully applied to differential pulley blocks, mechanism for moving buildings, gearing, shafting, driving knives on mowing machines, and various other purposes.

Among the machines invented by Mr. Arnold are a loom for weaving cloth on a bias, machines for making twill drills and mending stockings, a mariner's signal compass, a circular loom, and a machine for the manufacture of interlocked cordage. All of these were practical, but his most successful invention was a machine for making seines and nets for fishing. These were built in a number of ways, and the first patents were sold to a Baltimore firm in 1864. Since the expiration of the patents Mr. Arnold has built these machines for American and foreign manufacturers, shipments having been made to Baltimore, Chicago, Richmond, Va., North Carolina, Glasgow, Scotland and Barcelona, Spain. The ideas embodied in the netting machine are entirely original with Mr. Arnold, and a single machine, with a girl to attend it, will produce more netting in a day than can be turned out by forty hand-knitters.—*Providence Journal.*

Automatic Feed, Continuous Motion Ratchet Drill.

We illustrate herewith a ratchet drill having two ratchet wheels with pawls, one of these operating to drive the drill direct, while the other, by the opposite motion of the handle, drives the drill in the same direction by means of the bevel gears arranged as shown, these being keyed to their respective ratchet wheels, and connected by the intermediate, which runs loose on a stud. There is also a smaller pawl and ratchet teeth above, by which the feed is affected, and this pawl is so arranged that any desired rate of feed can be obtained.

By this arrangement the operation of the drill is practically continuous, and both hands can be used without the necessity for stopping to feed. It is manufactured in four sizes by J. F. McGrath, 187 School street, Taunton, Mass.



RATCHET DRILL.

Cam Movements—I.

BY A. D. PENTZ.

There is no doubt that every movement needed by mechanical engineers can be simply developed, and generally by a number of means.

Until recently links were looked upon with much favor, and a great deal of time has been consumed in determining the paths described by intricate combinations of these tantalizing arms. Yet those who need precise and involved movements generally are disappointed in their attempts to produce them by links. They usually have either to accept an approximation or take other means.

A short time ago cams were a last resort. They were thought necessarily to be noisy at high speeds, many of them were known to be harsh in action, and they had a reputation for wearing badly. Designers avoided them, but when they did use them in an emergency they were generally disappointed in that they did much better than was expected of them. It was also noticed in motions of considerable eccentricity that links always disappointed the engineer who used them, especially where the speed was at all high. They soon show wear. They become noisy and uncertain when loose. They are not necessarily easy motions, and they are astonishingly difficult to adjust, so that hard action and "sticks" may be eliminated and no looseness admitted. It is an impracticable mechanical feat to make a series of 8 or 10 joints in half as many pieces, and have them all assemble exactly parallel to each other and run smoothly in each of 10,000 machines.

At present cams are deservedly coming into high favor, and data relating to them is interesting reading to engineers. The writer knows of thousands of cases where cams similar to those in the succeeding sketches are running without objectionable noise, and in which the surfaces of the rollers travel more than 1,000 feet each minute. In some cases the movements are considered to be harsh, but they wear well, though made generally of gray cast-iron. I wish to say here that ordinarily it is not the cam that wears much, but the roller on its outside surface and on its stud, which is reduced in size and worn out of round. I wish further to say that in cams the friction is not a sliding one, except on the roller stud.

In this article, only cams cut within cylinders will be considered. Those within the face ends first, and those within the convex sides finally.

Fig. 1 shows the ordinary face cam *E* mounted on the shaft *G*, which has bearings in the stock *F*. The lever *A* operated by the cam through a roller *D* is pivoted at *B*. The motion derived from the cam *E* is multiplied in the lever *A* and delivered at the point *C* to whatever mechanism it is designed to operate. Of course levers of other kinds could reduce this motion or deliver it exactly as the cam develops it. In this sketch the motion derived from the cam is multiplied by 3 at the point *C*, because the arm *B D* is but one-third the entire length of the lever. Should the speed be high or the power to be delivered at *C* be considerable, this proportion will be bad; but if the contrary conditions are presented these proportions will be found to be satisfactory.

A cam of this kind is used quite as frequently to move a slide as it is to oscillate a lever. Generally the cam that operates one of these devices will operate the other, but if the motions are required to be precise they are laid out on diagrams having differing arrangements of web lines. A cam operating a slide or bar should be placed in relation to the roller on the slide so that the path of the roller should, if extended, pass exactly across the center of the cam. It is evident, therefore, that a diagram upon which a cam is to be designed for moving such a slide, and which shall take it just so far in a prescribed number of degrees, must be composed of radial web lines; such a diagram is shown in Fig. 2. It is laid out in radii 10 degrees apart. To design a cam on this diagram, which is to move a slide a certain distance and back each revolution, and exactly so far in each 10 degrees of revolution, all that is necessary to be done is first to draw two circles concentric to the diagram and to each other. The smaller circle to have a radius at least as great as the diameter of the roller to be used and the larger circle to have a radius greater than the smaller by the distance the slide is to be moved. Divide as much of one of the radial lines as is included between these two circles into eighteen equal parts, and through the intermediate points draw seventeen circles very faintly. Then, beginning at the inner point on one radial line, draw a continuous curve through each succeeding point of intersection outward, and on the next radial line, until the outer circumference is touched at the same point from both directions. This completes the central line for such cam.

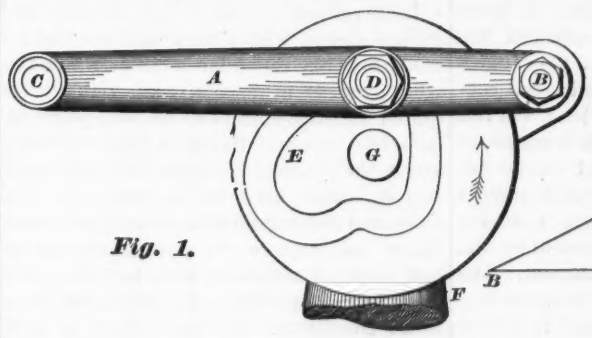


Fig. 1.

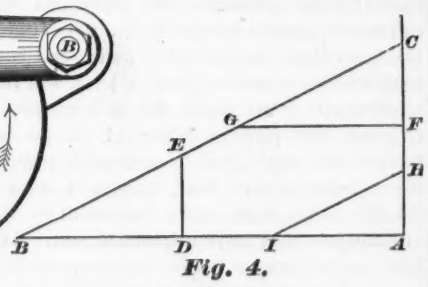


Fig. 4.

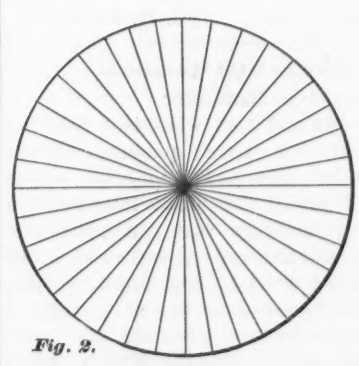


Fig. 2.

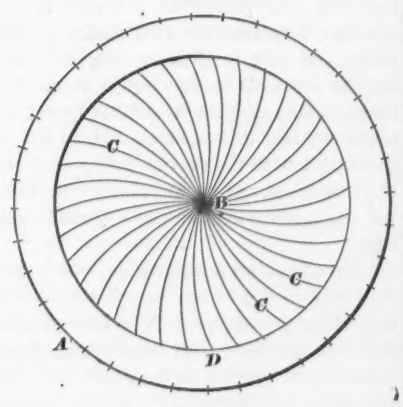


Fig. 3.

CAM MOVEMENTS.

The diagram for a cam to oscillate a lever is made like that in Fig. 3. The radius of the circle *A* is equal to the distance from *B*, the fulcrum of the lever, to the center of the cam that operates it The radius of *D* must at least be as great as the throw of the proposed cam, plus two diameters of the roller to be used. The circumference *A* is divided into thirty-six equal parts, and with dividers set to the radius of *A* the web lines *C C* are drawn in with the division points on circle *A* as centers. There is the same necessity for the roller in this cam oscillating toward the center, as in the cam which is to move a slide. Hence on this diagram some point on each one of the lines *C* indicates where the roller will be at that point of the revolution of the cam. The same rule given for a cam on the diagram in Fig. 2 is correct for the center line of a cam on this diagram if the cam is to move the lever equal degrees of oscillation for equal degrees of rotation. Cams of that character are, however, only suited to very moderate speeds, and therefore, except for indices and feed movements, they are but seldom employed. For high speeds every motion of a cam must be gently accelerated from one rest to a speed from which it can as gently be retarded to the next rest or reversal.

Sometimes with a given throw in a cam it is desired to know how far such cam will oscillate a given lever, or of what proportions the lever is required to be that shall be oscillated a given distance by a given cam, or with a given lever what the throw of the cam shall be. This can be found graphically by a diagram like Fig. 4. Draw the indefinite right angle *A B C*. Now, having a lever that is of the length *A C* from the fulcrum to the center of the cam roller, and which is of the length *A B* from the fulcrum to the delivery point, draw the diagonal *B C*; then if the throw of the cam be equal to *C F* the oscillation of the lever will be equal to the line *F G* parallel to *A B*. Again, should *A H* be the throw of the cam and *A I* be the desired throw of the lever, then a line parallel to *I H* will determine the comparative lengths of the two arms of the lever. For instance, if it be desired that *A C* shall be the length from the fulcrum to the center of the cam roller on the lever, then the distance *A B* will be the length from the fulcrum to the delivery point, for the lines *I H* and *B C* are parallel to each other. Furthermore, if *A C* be the distance from the cam roller to the fulcrum, and if *A B* be the length of the lever from the fulcrum to the delivery point, then if *B D* be the desired oscillation of the lever, the perpendicular *E D* will be the throw of the cam. Reduced to mathematics these dimensions are obtainable to any refinement desired.

If a writer would only remember to dot his i's and cross his t's he would save readers of manuscript a good deal of perplexity. This is a matter that has often been referred to, but it will bear further reference. The writer of this item perhaps feels it more deeply from the fact that he sometimes sins in this respect.

LETTERS FROM PRACTICAL MEN.

What is a Knot?

Editor American Machinist:

I notice a reference in your editorial page of the AMERICAN MACHINIST of this date to the subject of a difference between a knot and a nautical mile. I have not seen the discussion in the *Safety Valve*, but desire to call your attention to the fact that a knot, correctly speaking, is not a measure of length at all, but is simply a rate of speed, and as such is not synonymous with either a nautical or a statute mile.

It is incorrect, for instance, to refer to a vessel as traveling 350 knots a day, and the distance should be stated in miles, in which case nautical miles are always understood, and when a vessel is referred to as making so many knots it always means the given number of knots *an hour*. The use of the word knot for nautical mile is one of those colloquial expressions which may be permitted in conversation, but which is decidedly inaccurate, and not admissible in accurate writing.

A knot is a *rate of speed*, and to use it to indicate a distance is as incorrect as it would be to refer to a horse-power as equal to 33,000 foot-pounds without including the element of time. H. H. SUPLEE.

Editor American Machinist:

2,160 knots per hour. Rather swift? Well, ocean steamers are exceeding that every day. The above thought came when I was reading your remark to "the learned editor of the *Safety Valve*," in the AMERICAN MACHINIST for August 25th.

A *knot* is properly $\frac{1}{120}$ of a marine mile (or 50 72 feet. As the speed of a vessel is taken with a *half-minute glass* one can easily see why a speed of 18 knots is equivalent to a speed of 18 nautical miles per hour, which is the speed mentioned first (2,160 knots).

Current usage makes a knot equivalent to a nautical mile, and it is well, because if we say mile one is at a loss whether a statute or nautical mile is meant. The knot simplifies matters, and we do not have to bother with explanatory prefixes when telling the speed of vessels, etc. M. S. H.

Some Things.

Editor American Machinist:

Professor Sweet has been criticised for praise of foreign workmen and tools. While the professor's conclusions are generally well thought out, and in the main unassailable, all who have the pleasure of his acquaintance know that he is extremely modest and lacks self-assertion either for himself or his country.

The professor is a traveler, and has, no doubt, seen some wonderful things on the Continent—things hard to beat—especially when he does not tell us what these wonderful things were.

We were dazed with a continental planimeter a few years ago, when one of our young engineers pulled it in pieces and built a much better one out of the fragments.

The American bicycle has just recently cleaned them out in England.

On two occasions I saw engineering works in the British isles, and the machine tools and methods of doing work were far behind ours.

The reaper and sewing machine were born and raised here, and all the best typewriters smell of our soil.

Even in two-cent toys we "beat the Dutch."

Professor Sweet's brother, who is "quite English, you know," took occasion on one of his trips 'ome to get him a good pocket knife. He got it. He brought it back, and after bragging of its superior quality a few months, some one quietly pointed out the New Jersey stamp in small letters on the blade.

We can make things good—when we get paid for it—and we can slaughter work at low prices equal to any other nation.

Some one has been boasting lately on self-oiling journals.

I knew a concern in Wisconsin that made engines. The first engine they made ran 400 a minute 10 hours a day 9 *months*, with once oiling the main journals.

As I write my table is shaken by an unbalanced pulley lately put on a line shaft which has been running five years and has not been oiled since it started.

The trick lies in providing effectual means to make the oil leave the shaft at the ends of the bearings and go back in the reservoir.

High speed on railroads is attracting great attention. It is said that the speed of the New York State express is so great that it practically brings the telegraph poles so closely together that the train runs in a solid shadow. It is good for warm weather, but interferes somewhat with the view of the landscape.

I think that we will not attain the highest speed until the road-bed is made plumb solid, the tops of the rails planed or milled off dead straight, and the wheels ground true in the grinding lathe, and the engine made double compound, the reciprocating parts made to balance, and the counterweight taken out of the drivers.

Speaking of collisions at sea, why can we not do something with the *aura?* if any one knows what that is.

The great Tesla has made a glass globe with a flame inside, and he can, by coming within a few feet of the thing, and doubling his fist at it, make the flame dance and jump. He also says that he will make two *aura* machines so completely *en rapport* that you may take one and go to the uttermost parts of the earth, and I will stay here with the other, and we can, with these machines, talk together without cable or wire.

If this is so, why can we not have these wonderful machines on ships, and automatically arranged so as to wake up the captains and shock the man in the crow's nest while many leagues away? The longer we live the easier things get.

BENJ. F. WILSON.

Quarter Twist Belts.

Editor American Machinist:

I wish to comment on Mr. H. C. Heckendorn's treatment of this subject. I know that the rule given by the AMERICAN MACHINIST in answer to Query No. 241, June 2 issue, is correct theoretically, and a belt running slow and not lugging a load will run on the pulleys all right; nor is it necessary to crown the pulleys, either. I do not believe it does any good to crown the pulleys for a quarter turn belt, though I do not doubt that the taper pulley spoken of by Mr. Heckendorn may have helped him out. The belt creeps because it does not come in contact with the pulley as it would if it were straight between the two pulleys. To explain: the belt is slack on one side, and its weight causes it to sag, and if it moves fast the centrifugal force is another factor which tends to make it belly out, and so not come in contact with the driven pulley as it would if it were straight; therefore you have to set the pulley over enough to make up for that.

I have in mind a belt which, when moving slow with a light load, would run off on one side of the driven pulley, and when running fast with the same load would run off on the other; between the two speeds was one at which the belt would run on the pulleys all right.

The rule given by the AMERICAN MACHINIST is all right, but I am careful to leave room to move the pulley after I find out where the belt wants to run, and should advise any one else to do the same. J. L. D.

Cutting Bevel Gears.

Editor American Machinist:

I notice in your issue of April 21st a letter signed by Mr. Walter Gribben, and also in your issue of March 17th one sent by Mr. Easy Way. Mr. E. W., like a good many others, has been trying to obtain some information as regards to cutting bevel gears with a rotary gear cutter, and I should certainly uphold Mr. Gribben in asking E. W. to air his views. I have had considerable experience in cutting bevel gears with a gear cutter, and have never yet found anybody to give me any information as to how to cut them. They can tell you, just as Mr. G. says, what form of cutter to use, and what angle for bottom of tooth. This is only the start. I have written to all the authorities of gear cutting that I know of, and there is not one that can give me intelligent information. In fact, I know that I myself can cut a bevel gear, but cannot impart what knowledge I have to any one else.

The bevel gear cut with a rotary cutter seems to be surrounded with deep mystery. It had better be classed as deep ignorance, for there is not one of them that can tell any more than I have already stated. I should be only too happy to find one that can write it so that an ordinary intelligent man can cut a gear by it, or so that the finest engineer can take it and cut a bevel gear with their figures. If you can manage to gain any information it would be a great favor not only to me, but to all the readers of your valuable paper.

I think that a very good rule to follow in cutting bevel gears is, find the proper shape for the cutter, if you propose to make it yourself, get the angle of the bottom of the tooth; now do the rest with the old "cut and try" rule, and when you have the bevel gear so that it will run without being heard a couple of blocks away, then make a note of it, and you will know how to cut the duplicate of this gear; and after keeping notes for a number of years you may have a number of standards that you can cut all your gears to. But would advise you not to try to impart your knowledge to any one else.

ELLIS J. HANNUM.

The Flight of the Goose.

Editor American Machinist:

Mr. W. H. Harrison has taken up five columns of valuable space to disapprove some statements of Mr. Maxim's in regard to flight.

If all *his* statements are as badly out as those about the geese, he owes the readers of your paper an apology for writing his letter and taking up space that could be better filled.

He never saw a tame goose rise from the ground except with a very long run and directly towards the quarter from which the wind blew, as it evidently knew that it required the same current as an aëro plane to help him up; and though I know nothing about the science, I cannot help thinking that the effect must be the same in both cases, and that most birds are only animated planes and require the adverse current to help them. I never saw a sea bird rise from the water down wind, and I have seen them in all conditions. He never knew a wild goose to eat fish, and they will fly as many miles an hour as he puts them at a day.

J. H. BIRKETT.

The Inertia Question.

Editor American Machinist:

When you said that what is wanted is a term which will express quantitatively the resistance of inert bodies to being put in motion, I placed the broad interpretation upon your language that you meant that some means or method was needed by which such quantity could be determined, whether it involved the use of one or more terms.

Some of your correspondents have confined their criticism literally to the necessity for a new term to express inertia, and believe the vocabulary is now as complete as the present state of the science of dynamics requires.

One of your correspondents says that the resistance a body offers to being put in motion horizontally on a frictionless track will depend on the velocity of the motion. Of course it will, and this is an instance which shows the necessity of a means of determining this resistance quantitatively. It has been argued that there is no such thing as inertia. "Dynamics cannot recognize even a specific difference between rest and motion." Perhaps there is a want of general understanding as to what inertia really is. It is absurd to say that no such thing exists, when we see it manifested in our every-day experience.

A body supported above the earth begins its descent instantly upon the release of the support, and being urged by the constant force of gravity has its velocity uniformly accelerated until it meets the surface of the earth.

If the distance fallen through is 16 feet, it will reach the earth in one second of time, and have acquired a velocity of 32.2 feet per second.

In this case the moving force is already stored up in the body, every particle of which feels the pull of gravity, and the body only needs its support to be removed in order to begin its movement. If the same body is to be moved horizontally on a frictionless track by an equal amount of force, a different condition will exist; here the body is inert, and the force is brought to bear to move it, and before it can begin to move and hold together every particle must feel the effect of the moving force. In other words, the moving force must become diffused through the mass. Now it requires time for light and electricity to permeate a mass, and there is no good reason why force is not subject to the same thing.

It is this resistance or obstinacy of the body to movement during the impression of the moving force that I consider to be its inertia.

If the body is an elastic one, and the moving force is applied to one end, it can be readily conceived how the moving force is communicated from particle to particle, and how there may be considerable distortion of the body at the end where the force is applied before the opposite end feels the effect of the moving force.

A notable instance of the inertia of a body and its distortion during the impression of the force applied to move it is observed in the action of an explosive on the atmosphere, in which case the air is moved back by the expanding gas until the pressure of the latter is equal to that of the atmosphere. In the case of a quick explosive, as nitroglycerine, the evolution of the gas is so rapid that before the whole column of atmosphere is given movement the lower end is distorted or compressed to such an extent as to offer greater resistance than a granite block, upon which the explosion may have occurred. During the experiments of Professor Langley and Mr. Maxim, the gunmaker, with aeroplanes set inclined and moved through the air at various velocities, they found that as the velocity was increased the lifting power of the plane increased faster than that of the power required to drive it.

Professor Langley, who had no doubt mastered the theory of dynamics, and been accustomed to "rigid definitions of the terms used," failed at first to assign any cause for the phenomenon, but was content with simply stating the fact, while Maxim, who had probably not mastered the theory of dynamics, but had often encountered the obstacle of inertia in his experiments, at once assigned the true cause. He said the planes in advancing encountered successive masses of air at rest, which required to be displaced in order that the plane might progress, and it was the resistance this air offered to being displaced (its inertia) that caused the phenomenon. I. MCKIM CHASE.

Electrical Engineers—Ten-tenths Electrical, Balance Mechanical.

Editor American Machinist:

Apropos of a recent statement by a prominent educator of electrical engineers, that an E. E. should be "nine-tenths electrical and one-tenth mechanical," below are quoted some extracts from a discussion on the street railway motor before a meeting of the A. I. E. E., referring to the efficiency of spur gearing, that throw new light on this much mooted question.

"And especially street car gears must be very wasteful—from the fact that the transmission of power by gearing is at its best only when the height of the teeth is negligibly small compared with the radius of the gear; but in this high-speed gearing the pinion must necessarily be small, and then the height of the teeth is very perceptible compared with the radius of the pinion. In this case the gearing does not transmit with a fixed, but

with a varying ratio; *the teeth touch each other first with their heads, slide over each other and come out of impact when touching each other with their feet; that means that the ratio of transmission for each tooth which passes another varies between the ratio of the maximum and minimum radii of impact.*"

Italics are not the speaker's. Users of expensive and accurately formed cutters had better take heed of this information and avoid in the future the needless outlay entailed by the purchase of high-priced cutters, and go back to the thumbprint for their tooth shapes.

In the further discussion no voice was raised in the defense of the poor misguided manufacturers, and still worse for users of gear cutters. And yet the electrical street railway is a decided success. What might it not attain to of perfection—or of failure—were the E. E. five-tenths M. E.?

HENRY HESS.

Matrix Machines.

BY C. L. REDFIELD.

Having had considerable experience in endeavoring to make a successful matrix machine, a statement of some of the principal difficulties encountered, and the means employed to overcome them, may not be uninteresting to others struggling in the same line.

By matrix machine is meant one that uses a single font of steel type, and by impressing them in succession into a suitable material, produces intaglio impressions from which a stereotype or electrotype may be taken. The object is to produce the ordinary newspaper or book print without the necessity of setting up type either by hand or machine. In ordinary type-setting the compositor will do very well if he averages three words per minute during a day's work. Any one at all familiar with the speed attained on the typewriter will readily see that there is a considerable margin on which to work, and considerable profit to be made by any one that will make a good matrix machine that will approach anywhere near the speed of a typewriter.

A great many different kinds of material have been tried in which to make the impressions. So far the best material found seems to be paper, but just what quality of paper is best is yet uncertain.

Assuming, then, that paper be used, it is evident that some means must be provided for impressing the type, or dies as they are called, into the matrix, as the touch of the fingers would not furnish sufficient force, and if it would it could not be relied upon to always produce a uniform result. As all letters must be impressed to a uniform depth it is obvious that a hammer cannot be used for making the impressions, otherwise small letters like "i," "l" and the punctuation marks, would be impressed to a greater depth than the larger letters, like "M" and "W," because they would meet with less resistance in entering the matrix. It follows, therefore, that some device that gives a pressure instead of a blow is absolutely essential. The cam, the eccentric, the screw and the toggle joint have all been used with more or less success. It is a foregone conclusion that that device which has the least liability to looseness, and that which is the most certain to move a definite distance, is the best. In addition to these requirements the impressing device must be one that can be instantly set into motion for the purpose of saving time, and one that will make its movement quickly without producing what, in effect, would be a hammer blow. It will thus be seen that the number of well known devices that can be used satisfactorily is somewhat limited, and it will be found in attempting to make a simple, compact and convenient design, that there are a number of other limiting considerations. In my own practice I have found the best results by evolving a special device adapted to the form of machine I made.

Different letters and characters are of different widths, consequently a variable feed must be provided for that will act quickly, and be connected in some way with the various characters, or keys, if the machine has a keyboard. The production of a variable feeding device is an easy matter, but as the space between adjacent letters is usually less than .01", and as any irregularity of spacing will cause the printing to look bad, it is evident that the spacing device must be accurate, and must never under any circumstances have any lost motion, either as the result of wear, or from any other cause. The only method of accomplishing this result, as far as I am aware, is by means of a releasing device or escapement. A force feed is certainly out of the question. The requirement known, a variable escapement is not a very difficult device to construct, but it should be accurate, simple and compact, as the units of division are small, and it is liable to derangement unless well designed and well made.

Every machine of this class must have a fixed point at which all of the printing is made, and directly opposite which the impressing device should be placed. The problem of getting the dies quickly to and from this point, and causing them to be operated upon by the impressing device while there, is one of the most difficult of all. The three principal methods that have been tried by different parties for accomplishing this are: 1st. A wheel in which the type are held, and which carries them in succession past the printing point; 2d. A vibrating or reciprocating plate for the same purpose; and 3d. Supporting each die on separate carriers in a manner similar to that in use in the ordinary typewriter. Of these three methods the last is by far the best, though the hardest to make, on account of the difficulty of properly supporting and operating the impressing device. The question has to be solved, however, in more than one way, and now that the ice has been broken in this regard, future efforts in this line will meet with less obstacles than those in the past.

To have good printing, we must not only make all the impressions of a uniform depth, and provide the exact space required for each character, but we must maintain perfect alignment, and prevent every letter from turning on its axis, so as to assume a slanting position. Apparently the only way to accomplish this result is to do all printing through a properly formed guiding aperture, in a rigid plate. I have found that a hardened steel bushing in such a plate answers the purpose perfectly.

Passing from the machine proper to a consideration of the type and the matrix, what is probably the most difficult problem of all is encountered. To make good printing, the impressions should have a depth of about .02". Although printing may be made from impressions only one-half of this depth, it is better to have them deeper if possible. Any depth between .015" and .025" will probably be satisfactory, the latter depth being practically as deep as there is any advantage in going. The greater the depth, however, the more difficulty in obtaining good faces. This will be readily understood from a considera tion of the effect of impressing the dies into the matrix. Forcing a die into the matrix displaces a certain amount of material, and the greater the depth of the impression the more is displaced. This displaced material is distributed both downward and laterally. If the material is non-compressible, or thin and hard, it will flow from under and be distributed around the type; if it is thick and compressible it will be compacted beneath the type faces, and very little will be laterally distributed. As this lateral distribution of material is the principal stumbling-block that has been encountered in the efforts to produce good printing, it might be assumed that a very thick, easily compressible matrix would be a complete solution of the difficulty. Such would be the case if such a matrix did not involve other difficulties unnecessary to mention here. The proper solution of the question, therefore, is to make a compromise between thick and thin, and between compressible and non-compressible, and overcome the remaining part of the difficulty by making the dies in a special way. What this special form is depends largely upon other things. For a given quality of matrix material, and a given depth of impression (within reasonable limits), a form of die can be designed that will give practically perfect printing. This much has been demonstrated past any question.

Without touching upon the other details of the machine, or upon the means for justifying the lines and the correction of errors, for both of the latter of which there is a ready and simple solution, it remains only to speak of the production of the dies. Suppose a machine as perfect, as convenient and as durable as could be wished for, a matrix material that is perfectly satisfactory, and a form of die that would avoid all trouble of crowding, how are such dies to be produced in sufficient quantities to be of any practical value? Steel type punches are now cut by hand, and a few sets might be similarly cut for experimental use in matrix machines, but the idea that large quantities of exactly duplicate steel type could be cut by hand, except at enormous expense, is simply chimerical. They might be cast, but to do so would involve some different material and different process than those now in use. They could hardly be pressed or rolled, as typewriter type are, because the lines are much finer, and the sides should be highly finished. The best type for the purpo e are cut from steel, and subsequently hardened, and the person who undertakes to produce a matrix machine should know when, where and how he is to get his type. There are two different machines (both modern) that will do this work satisfactorily, but both are expensive, and both are hard to get. It is probable, however, that other parties will enter this field and produce other machines for type cutting, hence the efforts of the future are not likely to meet as severe obsta cles as those of the past.

In looking back over this field, and comparing the older efforts with the more recent ones made by different persons in various parts of the country, it is quite evident that there is and has been a steadily increasing amount of skill displayed. Taking this fact with the recent development of other things that are absolutely essential to success in this line, I must say that I am not at all surprised that the earlier matrix machines have failed.

Furthermore, I am satisfied that the present skill being exercised in this line will soon produce one or more successful matrix machines, and I think I am perfectly safe in asserting that the time is not far distant when machines of this class will be in common use.

Threatened Invasion of Cholera.

The dread disease Asiatic cholera is now threatening an invasion into the United States. Should it enter our ports this autumn, it is not likely to reach its full proportions till next summer, when, as regards the effect of its presence upon the Columbian Exposition, its prevalence would prove almost fatal to the success of that costly and elaborately planned enterprise.

This result, much as it would be lamented, would be far less to be regretted than the demonstrated fact that, in spite of the no table progress in sanitary science and engineering that has marked the last two decades, we should find ourselves powerless to stay the advance of one of the most fatal diseases to which mankind is subject. If it cannot be excluded, it can be obstructed, and it remains to be shown how far improved sanitary methods can prevail in combating its ravages.

If, as is now believed, cholera germs can be carried in meats, vegetables, milk, bread, and other articles of food, and in potable water, and if they are also carried about, as claimed by some, on the bodies of flies and other insects, it would seem highly improbable that in an infected community any one could be sure of escaping exposure, though the history of former epidemics shows that many do escape the disease.

Doubtless this fact proves that in different persons, and in the same person at different times, susceptibility to cholera is a variable quantity dependent upon the state of the nervous system, the condition of the alimentary canal, and probably upon other yet unknown factors. Since exposure is imminent, the possible avoidance of the disease, if it comes to us, must depend upon correct living; and the secret of correct living, together with avoidance of things known to be positively hurtful, as articles of diet tending directly to produce intestinal disturbance, is moderation. Moderation in work, in recreation, in eating and drinking, in everything that excites or stimulates to undue action any organ or vital function. The condition of impenetrable calmness of body and mind is the most impregnable obstacle to an attack of cholera.

Often, excitement of the digestive functions is brought about by a sudden change of diet. Extensive observation of this disease in a previous epidemic constrains the conclusion that such changes of diet, made through the desire to use articles of food supposed to be less liable to cause intestinal derangement than those commonly used, are no safeguard against cholera, but rather the reverse. Those who sought by a rigid selection and restriction of diet to evade attack were at least as frequently brought low as those who continued right on in the use of their accustomed food. Those who indulged appetite for food to excess, those who were careless of the quality of their food, and those who were most exposed by their environment to the germs of the disease were its most frequent victims.

It was noticed that those whose grief for the loss of near relatives was inordinate seemed doomed soon to follow the same path. There were also some curious anomalies. In one family three young and apparently vigorous persons were stricken and died within twenty-four hours, while the older and feebler people all escaped attack. Inordinate fear of the complaint appeared to be a powerfully predisposing cause, since people who displayed such fear seemed more liable to attack than those who bravely faced the danger.

To sum up the case, as far as relates to personal habits, he who is temperate in all things, avoiding all extremes, secures the greatest possible immunity under any enviroring conditions into which duty or necessity may lead him.

It is matter for congratulation that the particular vessels of the transatlantic fleet which are soon to fly the American flag will probably at that time, and until next season, at least, "hold the records" for time both ways, the "City of New York" having recently made the fastest eastward passage, while, as before announced, the "City of Paris" holds it for the westward passage. Though the "Teutonic" claims the fastest day's run, those of our readers who noticed Mr. Grant's letter in last week's issue, and our comments upon it, will probably surmise that we have serious doubts as to the basis of this claim.

Mr. Albert Stearns, of Brooklyn, has had prepared a number of photographs of the group of A. S. M. E. excursionists taken at Monterey, California, last May, the photograph being upon a card upon which is printed a numbered list of names, by means of which the faces may be identified. Each member of the California party is indebted to the kindness of Mr. Stearns for one of these photographs—a kindness which we are sure will be appreciated.

A recent Waco, Texas, dispatch says: The Waco Water and Light Company today filed in the county clerk's office a deed of trust to the Knickerbocker Trust Company, of New York, for five hundred thousand dollars. This trust deed is to secure the payment of bonds to that amount, the money to be used in extending the company's electric light, gas and water-works systems. The deed covers all the company's plant, real estate, franchise, etc.

We would like to know the present address of Mr. C. C. Hill, who has been a contributor to our columns.

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Turret Lathes, Screw Machines and Skill.

A recent writer on the subject of molding machines says, amongst other things: "Like the turret lathe, its best results are obtained when operated by unskilled labor, or by men trained only in the use of the machine." This reminds us that there is a good deal of misapprehension regarding the use of turret lathes, which it may be profitable to look into.

At first, and for a number of years, turret lathes or screw machines were used almost exclusively in factories, and very little in machine shops. They were, as they still are, used in manufacturing sewing machines, small arms and such similar work as is made in very large quantities, and requires vast numbers of small parts to be made precisely alike. These parts, if made in like quantities in lathes, would not have been made by real machinists, or even by good lathe hands, for two reasons: one reason being that a man specially trained to make a certain piece on the lathe, his tools selected and kept in order for him, so that he had practically nothing to do but to repeat certain movements and operations over and over again from one week's end to another could do the work just as well, and the other reason being that no good lathe hand or machinist could be kept at such work.

Now we will suppose a "regular Simon pure machinist"—proprietor of a Simon pure machine shop—a first-rate mechanic, but one who has never had any experience whatever in manufacturing machine work as distinguished from building it, and to whom the science of tool making is a sealed book, visits, say a sewing machine factory. He sees the screw machines turning out good work at what appears to him to be a prodigious rate, and when he learns that the men who are doing this make about half the wages that he pays his men, he is still more astonished, and is apt to think that he must have at least one turret lathe in his machine shop, an idea which the first tool builder he consults naturally takes some trouble to develop. The machine is put in, and a boy whose experience has been confined to running errands, with an occasional job on the drill press, is put to work at it with one of the "old hands," who has probably never seen such a machine before, as an instructor.

If any small tools were ordered with the machine, they are almost invariably the only ones ever made for it that are at all fitted to do good work, or any great quantity of very poor work, those made in the shop being usually finished at the forge or the grindstone, and of such a character as to give a genuine tool maker a feeling of intense disgust or of hilarious amusement, depending upon temperament.

But good tools would be wasted upon the boy who guides the destiny of the machine on its way to the scrap pile, and where, as sometimes happens, he is superseded by a youth tempted away from the sewing machine shop by an offer of higher wages, the result is little, if any better, because this youth knows nothing of making tools nor of keeping them in order, his training having been simply in using them.

What has been missed here is the fact that though comparatively unskilled and low-priced men are employed in factories to run such machines, the highest skill and the most extended experience is made use of, nevertheless, these being found in the man who is responsible for the work turned out upon these machines and who directs their operation. In such an establishment tools are used in connection with the machine that would not be justified on the same machine, where the character of the work and the number of pieces to be duplicated were entirely different, but nothing can be more certain than that a high degree of skill must be employed in connection with the operation of screw machines and turret lathes if the best results are to be obtained from their use.

When a turret lathe goes into a shop where it is the only machine of its class, where the changes from one job to another are comparatively frequent, and where there is no provision for supervision by a man accustomed to making tools and looking after work on such machines, it will be found in almost every instance that it will pay to have as good a man to operate the machine as is employed on any lathe in the shop, and this opinion is not based upon mere theory, but upon a somewhat extended experience with and observation of such machines.

The fact is that the choice of the kind of men to be employed should be influenced more by the character of the work to be done than by the means for doing it, and when any one jumps at the conclusion that because screw machines are operated by comparatively cheap men in factories, such men can, with such machines, turn out work in a machine shop that really requires good mechanics to do it on lathes, and can do this without the supervision of skilled mechanics who are specially versed in such machines, it is a mistake. Screw machines and turret lathes are wonderfully efficient, and in fact indispensable where the conditions call for them, but the broad statement quoted at the head of this article is by no means an accurate one, for whether a turret lathe will give best results operated by unskilled or by skilled labor will depend upon circumstances, and in any case the skilled and experienced supervision must be exercised if really good results are to be obtained.

The Coal Combine and Manufacturers.

What may be regarded as more or less in the nature of a victory for the people and for industrial interests is the decision referred to last week, by which the Reading Railroad is enjoined from controlling or operating the Central of New Jersey. The lease of this road is part of the scheme of what is known as the coal roads combination, which has succeeded already in increasing materially the cost of anthracite coal, and which seemed to be getting things into shape to still further increase it. That such a combination is contrary to public policy there can, of course, be no doubt whatever, and, this being the case, it was felt that, if there was none, there ought to be law which would prevent it. According to the decision of Chancellor McGill, there is such law, though President McLeod has coolly announced that the law will make no difference whatever in the practical operations of the combine, which will go on as before, with some modifications of the method of carrying on the business, these modifications being merely intended to "get around" the decision.

It has been denied on the part of the roads that they own any coal lands, or sell any coal, but, as is well known, either the roads or the most prominent men interested in them own sufficient stock in large coal companies to control them, so that the roads, pretending to act as common carriers, are not so in fact, so far as coal is concerned, for their action as carriers is influenced by the interests of these particular coal companies.

Chancellor McGill says that the pretensions of the roads on this point of interest in coal companies is "but disguise and evasion."

The grounds upon which the decision rests may be inferred from the following extract from it:

"The commodity in which these companies deal is a necessary of life in this State. It is the principal fuel of its homes and factories. The slightest increase in its price is felt by a population of hundreds of thousands of persons, for their necessity compels them to pay that increase. If once a complete monopoly be established by the destruction of competition, whether that be through lease or co operation, the promoters and sharers in it may have whatever price their cupidity suggests. The disaster which will follow cannot be measured. It will permeate the entire community, furnaces, forges, factories, and homes, leaving in its trail murmurs of discontent with a government which tolerates it, and all the other evil effects of oppression."

So long as other fuels—bituminous coal and oil, for instance—can compete with anthracite, it does not seem to be strictly true that any price suggested by cupidity can be had by the companies, but the success of such a combination, and the discovery that the competition of other fuels prevented a sufficiently high price to satisfy cupidity, might easily lead to a further combination, which might remove this obstacle. Even now some of the coal trade journals, which are short-sighted enough to think that by such combinations the best interests of the coal business can be conserved, are advising a combination of soft coal interests, in imitation of the hard coal combine. One of these journals, the *Black Diamond*, recently said that "Soft coal exists in such profuse quantities on every hand, and of such a variety of grades, that the economics of trade, followed by those who are interested in the industry, are greatly at variance with what might be called the standard of the hard coal business.". . . .

"If a large number of operators in the soft coal business sought with greater zeal to see how much profit they could materialize out of the industry, rather than how cheaply they could sell their product, there would be less competition and more money in the soft coal business. An attempt, not at consolidation, but at harmony on this matter, would be productive of the most beneficial results. So far as the consumer is concerned, he does not in any way appreciate their somewhat disinterested labors. If he could buy coal at fifty cents a ton he would indulge in the same amount of criticism and carping, and it may be villification, as he does now, and if he paid a fifty cents advance upon prevalent prices, the music would be about the same. Hence, it becomes a matter for practical consideration upon the part of soft coal producers whether some modification of their existing policy might not be introduced to their advantage."

The same authority then goes on to make light of a proposed investigation by Congress into the coal combine, and speaks of a "power sufficiently arbitrary to manipulate a private business," as though the officers of the roads concerned had nothing to consider whatever except their private interests or those of the companies represented by them.

The vast majority of the manufactures of this country are, and must ever remain, competitive. In our opinion there never can be any effective combination of manufacturers of say steam engines, or of tools, or of a thousand other lines of manufacture which might be mentioned, where the choice of a purchaser is governed by other things as much as or more than by first cost. These interests, to say nothing of those of private consumers of coal, will always stand in the way of unlimited operations of coal combines. If there are now no laws that seriously embarrass their operations, such laws will certainly be passed. The great body of the people who pay for their coal with money earned by honest toil, and manufacturers who cannot, if they would, form combinations of their own, will demand this, and that which they unitedly demand in the way of legislation they will have.

When an application for a patent is received at Washington and placed in the hands of an examiner that examiner seems usually to feel as though he must do something to earn his salary, and to do this must refer the applicant to previously patented devices supposed to stand in the way of the granting of the new patent. It sometimes happens that a really new device is presented for patent protection, and when this occurs it is, of course, difficult to cite previous cases covering the ground; but this makes no difference whatever to the average examiner, he simply refers to the first thing he runs across that seems to belong to the same class, though it may be different in function, in principle and method of operation. An engineer who is applying for a patent on an improvement in air-brake mechanism received some such reference recently, and in speaking of it said that the device cited by the examiner resembled his

about as a nursing bottle resembled a baby carriage; these may both be used on the same child, and there the resemblance ceases. The result in this particular instance was that the attorney who had charge of the application immediately broadened the claim on the new device. Of course such references do not eventually stand in the way of the granting of a patent, and are probably not intended to do anything more than give the examiner and the patent solicitor a chance to "earn their keep," but they do often serve to unnecessarily delay matters when delay in some cases is injurious to important interests.

Rules Should Be Honest.

We have in times past referred to the practice on most railroads of making rules for the guidance of employes that were not expected to be observed, and the observance of which would be utterly inconsistent with other rules, and with the well understood requirements imposed by the company upon its employes.

Many rules for the government of engineers with respect to speed are of this character, the mere reading of many such rules being well calculated to make the uninitiated think that every possible safeguard was thrown around the movement of trains, but the engineers understand perfectly well that the officials of the road demand that trains shall be on time, rules or no rules, and even when it is known practically that rules must be violated in order to make the time.

Another rule of this character is the one requiring brakemen to use a stick in coupling cars. It is not intended that this rule shall be observed, and its only use is in trials of suits for damages by injured brakemen, when it is trotted out to show that the injury was the result of violation of rules by the injured man, and that the company is therefore not liable.

A case has recently been settled that is of interest in this connection. Suit was first brought in the U. S. Court for the southern district of South Carolina for damages for the death of a brakeman who was killed while coupling cars, he having signed an agreement recognizing a rule which forbade him coupling cars without a stick, and waiving all rights to recover damages for injuries received while violating this rule. The court decided that this was a good defense for the company, and refused to award damages; but the U. S. Court of Appeals has reversed this judgment, on the ground that, being constantly and regularly disregarded by the employes, with the full knowledge of the officers of the road, the rule was inoperative.

There have been some recent rulings of courts to the effect that railroad commissioners could not constitutionally compel railroads to handle freight at a loss This means that when a road has watered its stock up to three or four times its cost, there must accrue to all this watered stock a fair dividend on the money that has not been invested.

The Pope Manufacturing Company, of Hartford, Conn., state that the pneumatic tires and ball bearings on the sulky pulled by "Nancy Hanks" when she broke the trotting record were made by them.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(373) F. J., Pawtucket, R. I., writes: Kindly inform me through your columns whether there is any substance which can be placed in drawing ink to keep flies from eating it off the drawing. *A.*—We have found by experience that this annoyance can be prevented by mixing up fresh ink every morning and afternoon. We know of no other remedy.

(374) E. T. B., ——, writes: Will you tell me how to become a good machinist? I am 19 years old, understand engines and steam, and have been working for four years in shops, doing rough work. *A.*—There is no "Royal Road" to becoming a good machinist. If you become a good machinist it will be by virtue of good, honest, hard endeavor. Work in the best shops you can get access to, and read and study in your leisure hours. That is the way, and the only way, that men make themselves good machinists.

(375) J. C., Newport News, Va., writes: Kindly publish a rule for solving problems similar to the following: Suppose a coupling is open $\frac{1}{12}$ inch on top, the coupling being 26 inches diameter and the shaft 8 feet 4 inches long, how can I find the exact thickness of liner to be placed under the end of the shaft to bring the coupling face to face? *A.*—Multiply the amount of opening on top of coupling by the length of shaft, and divide the product by the diameter of the coupling. Applying this rule to your example we have $\frac{.0312 \times 100}{26} = 0.12$ inch, which is a little less than $\frac{1}{8}$ inch.

(376) E. R., Buffalo, N. Y., writes: I would like to be informed how to lay out a certain number of holes in a circle, say four feet radius. I have a number to lay out, and want to avoid spacing them off. Please do not give algebra, as I do not understand it. *A.*—If the holes are as close as rivet holes, you will have to space them off. If there are only 6 holes in the whole circumference, then the shortest distance between their centers will be exactly equal to the radius. By bisecting these distances you will obtain 12 holes, and again bisecting the latter you will obtain 24 holes, and so on.

(377) E. S. H., St. Louis, Mo., writes: Will you kindly publish in your columns the body, sheer, and half-breadth plan, and a description of the engine and boiler of steam launch "Norwood"? If not convenient for you to do so, then please let me know where I could find the above requested plans and description. *A.*—You will find a description of the boat, engine and boiler, with an illustration of the latter, in our issue of September 18, 1890. Designers usually prefer not to give the lines of their fast boats, but if we can obtain them we shall publish them. The designer of the boat, engine and boiler is C. D. Mosher, Amesbury, Mass.

(378) B. A., Waynesboro, Va., writes: The inclosed slip is a clipping from a catalogue of a prominent firm manufacturing Corliss and other engines. The motion referred to is a motion of a Corliss valve gear. I do not know what is meant by the mathematical process mentioned, nor have I been able to find any kind of publication on the subject. If there are mathematical or graphical methods of analyzing and designing Corliss gears, I and many others would be pleased to have it explained. *A.*—There are several modified types of the Corliss gear. Send us the type to which you refer, and we shall take pleasure in explaining it.

(379) R. M., Bologna, Italy, writes: I need to temper very hard two iron cylinders 70 m/m in diameter, and 170 m/m long. Be kind enough and inform me how to do so. The hardness is to extend into the metal 3 m/m. *A.*—We presume that the cylinders are made of wrought-iron. These require to be case-hardened. This is accomplished by packing the cylinders in bone dust in an iron box and then heating the whole. When hot enough a steady heat is maintained for about say 12 hours, and then gradually lowered during another hour, after which the cylinders are taken out of the box and thoroughly cooled in water and quickly dried, to prevent rusting. For a complete description of this process see our issues of June 23, 1888; May 22 and June 5, 1890.

(380) F. L. H., New York, writes: I am a steam fitter by trade, and contemplate building a steam launch, not of wood, but of galvanized iron $\frac{3}{16}$ inch thick. I intend to have the ribs of wrought-iron, and place them within a foot apart. I do not intend to rivet the sheets together, but use bolts and nuts and rubber packing to screw up everything perfectly tight. Would it be advisable to do so or not? What is your idea on this subject? Would the rubber packing do for salt water? *A.*—We should use rivets, as with these a far better job can be obtained than with bolts. We do not favor the rubber packing, as it will become useless in time and cause leaks. 2. Do you think iron will answer the purpose better than wood for wear and strength? *A.*—The iron will give a stronger boat and wear better than wood, provided the workmanship is good. But you will have considerable more labor in building an iron boat than a wooden one, and, unless you have the necessary tools and experience, we should not advise you to attempt it, as this is a trade by itself. 3. Could all the seams be soldered? *A.*—Yes.

(381) W. T., Windsor, Ont., writes: I have taken your paper for a considerable time, and take great interest in it, as I have derived quite an amount of information from it. I would like you to answer the following through your columns: In taking the length of an eccentric rod of a slide valve marine engine, should it not be taken from center of pin in link to center of eccentric? My reason for thinking that it should be is that when you alter the lap you have to change the eccentric, and therefore alter the rod. *A.*—In setting the valve motion the length of eccentric rod is always taken from center of eccentric to center of pin in link. You are correct in saying that when the lap is changed the position of eccentric must also be changed; but you are wrong in saying that the length of rod must be changed. The lap does not affect the length of eccentric rod; when this length has been correctly determined, it is correct for any amount of lap. 2. If the radius of the link is correct and the whole valve motion correctly set, should the valve move when thrown from forward to backward gear? *A.*—The valve will always move more or less in reversing. When the piston is at the end of a stroke, the movement of the valve is very small, or practically nothing, as it will occupy the same position in either forward or backward gear after the motion has been reversed.

(382) X. Y. Z., Pittsburgh, Pa., writes: Please inform me through your columns in regard to the following: What pressure must be exerted on cylinder walls by the piston packing rings of a gas engine to hold an initial pressure of 240 pounds? Give formula for finding this pressure. *A.*—There is no formula for ascertaining this pressure, and none is needed. If the piston packing rings are made of cast iron and sprung into grooves in the piston, and the workmanship is good, there will be no trouble of leaking. Many packing rings are set out by springs so that the pressure can be regulated to suit conditions without paying any attention to the exact pressure between rings and cylinder walls. Of course care must be taken so as not to have an excessive pressure which may produce abrasion. 2. What is the formula for finding the dimensions of that class of rings which are sprung into place and depend on their elasticity for keeping tight? *A.*—There is no formula for determining these dimensions. We have seen steel rings about $\frac{3}{16}$ inch square used for pistons 6 inches diameter; cast iron rings for the same diameter should be about $\frac{3}{4}$ inch square and this section should gradually increase with the diameter of cylinder so as to make the ring $\frac{3}{4}$ inch square for cylinders 20 inches diameter. Some mechanics prefer to make the depth of cross-section of the ring greater than the width, and others prefer to make the depth less than the width. Experience is the best guide in matters of this kind. 3. What is the best material for such rings for gas engines with cylinders say 4½x6 inches; initial pressure 240 pounds? *A.*—For diameters as small as this we should use three steel rings with a cross-section of $\frac{3}{16}$ inch square. For larger cylinders we should prefer cast-iron packing rings.

(383) F. M., Philadelphia, Pa., writes: Several of us have had a dispute in regard to a steam plant that was put up some years ago: it has not sufficient draught. I have inclosed a blue print of the plant. The stack was originally designed for about 700 horse-power, but we are now using four boilers only, each 100 horse power, making a total of 400 horse-power. The grate under each boiler is 4x8 feet, giving 32 square feet of grate surface. The area of flue from each boiler is 400 square inches, and the flue leading to stack has an area of 2,127 square inches. The stack is of iron, lined inside with brick; the inside diameter is 5 feet 4 inches; height of stack, 121 feet. The temperature at the bottom of the stack, ascertained with a thermometer, is 280 degrees; at the middle of the horizontal flue, 320 degrees; in the flues inside of the boiler house, 400 degrees, and at the damper of each boiler, 420 to 450 degrees. We all agree upon one point, and that is that the stack is too large in diameter for the plant. I write to ask you if, after investigating the matter, you will express an opinion in regard to it, and also let me know what would be the quickest way to remedy the trouble? *A.*—The diameter of the chimney is too large. For determining the diameter it is best to take into account the amount of coal burnt per hour, which you have not given. Assuming that 1,550 pounds of coal are burnt per hour, the diameter of the chimney for the given height should be 48 inches, the area of which is 1,809 square inches. The simplest way of reducing the area of the present chimney is to build in it a brick partition, leaving a working area of 1,809 square inches. The area of the flues in the boiler room running to the horizontal flue is too small; we believe better results can be obtained by increasing it 25 per cent. 2. Another pipe, with an area of 450 square inches, from an annealing and melting room, leads into the flue of stack. Will this pipe weaken the draught in the stack? *A.*—We believe not; but this can be easily ascertained by stopping work for a day or two in the annealing and melting room, and noticing the effect on the draught of chimney. 3. You will find on drawing that the flue leading to chimney has an area of 2.127 square inches only, which is large enough for the present; but I think it would be too small in case we should increase the plant in the future. *A.*—You are correct.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

It is a fact. See Grant, p. 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

A. D. Pentz, Consulting. Tools. Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago. New lists of cutters. Brown & Sharpe.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Holbrook's new loaded rawhide mallets.

Automatic Gear Cutters. Best in the market. Superior Machine Works, 108 Canal St., Cleve'd, O.

Pulley lathes, most efficient offered. Ohio Machine Tool Works, Cincinnati, O.

J. S. Thurman, M. E., Indianapolis, Ind., Expert Patent Solicitor. Inventions Perfected.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

25" } "Only Drill Press built on
32" } 'Ko-rekt' principles,
37" } Even if they come from Jersey."
42" } Gould & Eberhardt, New Ark, N. J.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 208 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Gascon Discourses Upon Some Shortcomings in Text-books—Do Not Always Tell of Improvements.

BY JARNO.

"After looking at cuts that befog rather than illustrate the text, it is curious to come upon a case in which the text does not tell the later improvements shown in the cut. Such a case is likely to occur when cuts are not made especially for the text-book, but are borrowed from manufacturers' catalogues. Authors that complain of the difficulty of having correct cuts made would do well to see to it that their own text is as "modern" as the cuts they borrow.

"A notable case is an improved cap for the pillow blocks of stationary steam engines. This improvement consists in casting lugs on the caps to hook over the two parts or uprights that hold the boxes, so as to avoid breaking the block when undue shock is brought upon the boxes by the crank-shaft bearing, sometimes brought about by getting too loose. The better class of engine builders make these hook lugs a snug fit upon the pillow block uprights, so as to have the cap a real tie.

"One story of this improvement is something like this: When the hook lugs were

first added, the caps still had the old kind of lugs or ribs that fitted inside the uprights, just over the boxes. As every machinist knows, it is better to avoid, as much as practicable, the difficulty of fitting one piece both inside and outside another piece, so that, after a time, the inside lugs were omitted. Then it became known that some pillow blocks had been made of too weak design through the bottom under the boxes. This weakness would call the tie cap into use, so far as the preventing of the spreading of the uprights; but there was another trouble. The great weight of the fly-wheel and the crank-shaft would sometimes spring the pillow block downward so much as to tend to close the uprights upon the boxes and bind the bearings. This tendency was not now so much resisted by the cap, because its inner shoulders or ribs had been left off, and so an extra rib had to be added between the feet of future pillow blocks.

"In passing by a neighboring machine shop that builds engines, I notice blocks that still retain the inside shoulders, or ribs.

"To mention the books that do not tell about this tie cap would be to make a list of all the text-books I know of. It should certainly seem that a recent book on the steam engine by Holmes, and also Unwin's 'Elements of Machine Design,' would illustrate this block and give formulas for proportioning it. Cuts of it are in Appleton's 'Cyclopedia of Applied Mechanics,' vol. 1, page 690, and Rose's 'Modern Machine Shop Practice,' vol. 2, page 146.

"Several lathe builders are applying tie caps to spindle boxes, but of these I have not as yet seen even a cut."

I should like to pin this rider to Gascon's manuscript: I hope to see technical writers more accurate in the choice of words. Mr. Rose, on the page just referred to, speaks of condensing the area of a surface. If, in the accurate use of words, we can "condense an area," we might also condense a length. He also says that box brasses condense and stretch. We know that he means that they are made thinner and longer, but we know it because we are mechanics, and not from any information contained in the expression, "condense and stretch." It would be quite as consistent to say that a thing is expanded and shortened. The word "modern" is much overloaded; we have too many things called modern. Words are like steam engines; they may be so much overloaded as to become unable to do even the work they were intended to do. "Modern" and "Revised Edition," when put into the titles of books, soon become misnomers. It is much better to name the year of publication in the title. I have just received the prospectus of a book to be called "Modern Mechanism." In a few years the publishers will be hunting around for a name to a revision. I am reminded of the story of a man that built a machine which he improved upon in a second machine. The second he sold under the name of the improved machine. Then followed another which he called the new improved. At last accounts he is making still better machines, but he has decided to employ shorter names.

Prevention of Cholera.

A circular of the New York Board of Health is as follows:

Healthy persons "catch" cholera by taking into their systems through the mouth, as in their food or drink, or from their hands, knives, forks, plates, tumblers, clothing, etc., the germs of the disease which are always present in the discharges from the stomach and bowels of those sick with cholera.

Thorough cooking destroys the cholera germs; therefore,

Don't eat raw, uncooked articles of any kind, not even milk.

Don't eat or drink to excess. Use plain, wholesome, digestible food, as indigestion and diarrhea favor an attack of cholera.

Don't drink unboiled water.

Don't eat or drink articles unless they have been thoroughly and recently cooked or boiled, and the more recent and hotter they are, the safer.

Don't employ utensils in eating or drinking unless they have been recently put in boiling water; the more recent, the safer.

Don't eat or handle food or drink with unwashed hands, or receive it from the unwashed hands of others.

Don't use the hands for any purpose when soiled with cholera discharges; thoroughly cleanse them at once.

Personal cleanliness, and cleanliness of the living and sleeping rooms and their contents, and thorough ventilation should be rigidly enforced. Foul water-closets, sinks, Croton faucets, cellars, etc., should be avoided, and when present should be referred to the Health Board at once and be remedied.

PRECAUTIONARY MEASURES OF TREATMENT.

The successful treatment and the prevention of the spread of this disease demand that its earliest manifestations be promptly recognized and treated; therefore,

Don't doctor yourself for bowel complaint, but go to bed and send for the nearest physician at once. Send for your family physician; send to a dispensary or hospital; send to the Health Department; send to the nearest police station for medical aid.

Don't wait, but send at once. If taken ill in the street seek the nearest drug store, dispensary, hospital or police station, and demand prompt medical attention.

Don't permit vomit or diarrheal discharges to come in contact with food, drink or clothing. These discharges should be received in proper vessels and kept covered until removed under competent directions. Pour boiling water on them, put a strong solution of carbolic acid in them (not less than one part of acid to twenty of hot soapsuds or water).

Don't wear, handle or use any articles of clothing or furniture that are soiled with cholera discharges. Pour boiling water on them or put them into it, and scrub them with the carbolic acid solution mentioned above, and promptly request the Health Board to remove them.

Don't be frightened, but do be cautious and avoid excesses and unnecessary exposures of every kind.

By order of the Board of Health.

Crucible Steel for Boiler Plates.

Since the discussion at the Master Mechanics' Convention on boiler steel, and the impression given out that some crucible steel sheets had given extraordinary mileage in fire boxes, there has been a tendency to regard crucible steel as being particularly valuable for boiler purposes. We believe that this impression is at best a fallacy, and that there is no kind of steel so well adapted for fire boxes as the open hearth steel that is commonly in use. It seems certain that the tendency to break down prices has brought into the market steel of inferior quality, which is not well adapted for use in fire boxes. Many railroad officers are now saying that they are prepared to pay any reasonable price for good boiler steel, and their eyes are turned toward crucible steel as the material that is going to realize all their expectations. We would caution our friends not to be precipitant in employing this material for fire boxes. Those who are considering the merits of crucible steel will do well to study a report that was submitted to the Master Mechanics' Convention in 1888. In that report the following points were made about crucible steel:

"The crucible process of making steel is the oldest, commercially speaking, and for some purposes the best—that is, when steel is wanted in small quantities of considerable purity. It is a failure when large masses of homogeneous character are required, as is the case in boiler plate. Its shortcomings in this respect are due to the process of manufacture, which, as is well known, consists in melting wrought-iron, etc., in a crucible holding generally from 80 to 125 pounds. To obtain a mass large enough to make boiler plate, it is necessary to pour the contents of from 20 to 50 crucibles into one mold to form an ingot. As the 'steel' is made in each crucible, it follows that in 30 crucibles we have 30 different kinds and grades of steel in the one sheet. The result, when subjected to the trying conditions found in a locomotive fire box, is, of course, disastrous in the majority of cases, as homogeneity or absolute uniformity of the metal in this service is one of the most important elements found in long-lived fire boxes."—*Locomotive Engineering.*

The authorities of New Jersey are evidently in deadly earnest in their efforts to break up the iniquitous combination which has already succeeded in adding a dollar a ton to the price of coal. Attorney-General Stockton is preparing himself to break up the connection between the Lehigh Valley and Reading companies. The people of New Jersey and its neighboring States will heartily approve of the attempt to rescue them from the grasp of Mr. McLeod's trust, and will hope that his insolent intention to disregard the law and to snap his fingers at the courts will not be successful.—*The World.*

Geo. W. Richardson.

Mr. Geo. W. Richardson, a well-known mechanic, inventor of the "Pop" safety valve, so extensively used on locomotives, died at his home in Bridgeport, Conn., Thursday evening at eight o'clock. Some account of his life will be given next week.

MANUFACTURES.

A new saw-mill is to be erected at Burnham Maine

The Kyle (Texas) oil-mill has been completed, and has opened for business.

The Falcon Mill, Niles, O., is having built two engines, 36 and 28-inch cylinders.

The oil-mill building at Decatur, Texas, is finished, and ready for the machinery.

Work has been resumed at the Thistle and Appanoose shafts at Centreville, Iowa.

The Trimble Brick Mfg. Co., of Trimble, O., have increased their capital stock from $20,000 to $40,000.

Articles of incorporation have been filed by the Bascom Mfg. Co., of Cleveland, O., with a capital stock of $10,000.

Articles of incorporation have been filed by the Hendrickson Mfg. Co., of Paulding, O, with a capital stock of $25,000.

The Cowpens Manufacturing Company, Cowpens, S. C., will add 2,000 spindles and necessary equipment to its cotton-mill.

Squirrel Island, Maine, is having a splendid water system introduced from Spring Cove. It will be completed this season.

Albany (Wis.) people have subscribed $10 000 towards a $150,000 linen-mill, employing 150 hands. It will be one of the largest and best equipped in the Northwest.

A new lace-mill will be started at Columbia, Pa., in September. It is a new industry imported from Scotland, and will give employment to several hundred people.

Mr. John H. Buxton has received the franchise for the erection of a water-works supply at Crisfield, Md. (70 feet high stand pipe). Eight-inch pipe will be used.

Bloom Furnace, of Wm. Neal & Sons, Bloomsburg, Pa., shut down the early part of July. It is the intention to put this furnace in blast again about September 1.

The new pipe works at Rusk, Texas, will go into operation in about a month. Its daily capacity will be 75 tons standard pipe, and it has orders on hand to keep it going 12 months.

A corporation named the Neponset Steel Casting Company has been recently organized, and has purchased an extensive established plant at Neponset, Mass., which will soon be in operation.

A company has been organized by Northern capitalists for the manufacture of the International typewriter at Bessemer City, N. C. It is said that William C. Whitney, of New York, is interested.

The McVay Galvanized and Corrugated Steel Company's plant at Chicago, Ill., is to be torn down and moved to Muncie, Ind., to be run in connection with the Midland Steel Company's plant.

The Mahoning Valley Iron Company, of Youngstown, O., is now working its nail factory and shafting departments. The furnace, which is now blown out, will likely be relined in the near future.

The excavation for the foundation of the laundry on Center Island, N. Y., has been nearly completed. A large quantity of stone arrived to day, and the masons will commence work the early part of next week.

An engineer from Chicago is conferring with the authorities at Neenah, Wis., relative to the inaugurating of water-works. His plan is to take the water from Lake Winnebago 1,400 feet from the shore.

The Bellaire (O.) Stove Works is doing an excellent business. Its facilities are taxed to the utmost capacity to put out its orders, and will soon be compelled to build an addition to its already large works.

A Pottstown (Pa.) dispatch says that, "owing to the very general improvement in the iron market, the steel works at Stowe, near Pottstown, will increase its force of operatives several hundred men and run on double time, beginning August 24."

The new whip factory at Wellsville, Pa., will be 200x84 feet, three stories high. It will be one of the largest of its kind in the county when completed. Twelve new houses have been erected at Wellsville this year. The village is having a boom in the building line.

G. L. Loope, W. F. Swift and C. S. Bundy have incorporated the Mexican Powder Company, at Covington, Ky., to manufacture and sell dynamite and powder; capital stock, $2,500,000. The company is to have branch offices at Yosemite, Ky., and in Michigan, Illinois and Mexico.

The work of removing the equipment of the Standard Axle Works, of Wheeling, W. Va., and replacing it with machinery for the Warwood Tool Works, has been going on for some time. A large force has been steadily employed. It is expected to have the works in operation soon.

There is water-works agitation at Keyport, N. J.; Atlantic Highlands, N. J.; Forest Grove, Ore.; Lonaconing, Md.; Depew, N. Y.; Girard, Pa.; Pullman, Wash.; Athena, Ore.; Milan, Tenn.; Saybrook, Ill.; Moorestown, N. J.; Reading, O; Santa Fe, N. M.; McKinney, Texas; Piedmont, West Va.

Bartlett & Company, 21-23 Rose street, New York, who make a specialty of high grade catalogues for manufacturers, have issued a very artistic pamphlet, explaining the nature of their business, and its advantages to manufacturers of machinery and others. It is sent on application.

The Waldo and Penobscot Agricultural Society is about to establish a system of water-works on their park at Monroe, Maine, by taking water from the lowland springs and conveying it to the desired spot by the use of a wind-mill. The village, which is situated on a lower elevation, may be watered the same way.

Mr. Thomas Lowry, a well-known capitalist, has organized the Minneapolis Improvement Company, North East, of Minneapolis, Minn., with a capital of $2,000,000, of which he will be president. The company will locate manufacturing plants on a tract of 1,100 acres, just outside of the city limits, owned by it. The electric car lines will be extended into the grounds.

The Brown & Sharpe Mfg. Co., of Providence, R. I., have issued a new edition of their pamphlet on their universal cutter and reamer grinder. The matter has been entirely rewritten, and a number of new illustrations added, some of these relating to new devices. The pamphlet contains information on the matter of grinding cutters that is useful to the user of any cutter grinder, and is sent free to any address upon application.

The Pittsburgh Rolled Axle Company has been recently incorporated, with a capital stock of $350,000. Among the directors of the new concern are John S. McIntosh, of Walls Station, and Watkins T. Williams, of Braddock. E. E. Slick, a draftsman at the Edgar Thomson steel works, is interested in the device, from which it is claimed car axles in iron or steel can be rolled direct. The new company will lease property for a test plant.

Owing to a rapidly increasing business, the Howard Brothers Manufacturing Company, of Worcester, Mass., have for some time been greatly inconvenienced by lack of space. They are now building a new shop at the corner of Vine and Franklin streets, 100x87.6 feet at the widest point, and four stories high. The building will be completed by the middle of September, and before the beginning of October the company expect to have their new plant in full operation.

The Ashley Engineering Co., whose offices are at 136 Liberty street, N. Y., has recently completed at Hawthorne, N. J., a new brick shop, 22x45 feet, two stories high, with an extension for boilers. They are at present employing ten men on patented specialties, mostly relating to the use of steam, such as steam and water traps, damper regulators, automatic boiler feeders, electric and other low-water alarms, etc. Two pattern makers are at present employed in getting out patterns for new work.

The Washburn & Moen Mfg. Co., of Worcester, Mass., have taken out a permit for erecting a new mill building of large dimensions at the Quinsigamond Works for the manufacture of all kinds of wire springs. Between 200 and 300 hands will be employed in this department, and new and costly machinery is already being made for the new plant. The company have heretofore made only a limited variety of springs, but now propose to make nearly every kind of wire spring called for by the trade.

The Berlin Iron Bridge Co., of East Berlin, Conn., are putting up two iron buildings for the Randolph & Clowes Co., at Waterbury, Conn. One a casting shop 42 feet wide by 82 feet long, and another a pickle room 25 feet wide by 100 feet long. The Berlin Company are also building a new gas house for the Philadelphia & Reading Railroad, at Philadelphia, Pa., a new retort house for the Geo. H.

Morrill Co., of Boston, Mass., and a new boiler house for the Pope Mfg. Co., at Hartford, Conn. All of these buildings are to be of iron, after the well-known plans of the Berlin Company.

Articles of incorporation have been filed by the Lodge & Shipley Machine Tool Co., Cincinnati, O., with a paid-up capital stock of $100,000. The new company succeeds to the plant and business of the Ohio Machine Tool Co., William Lodge, proprietor, and with Mr. William Lodge as president and general manager, and Mr. Murray Shipley, Jr., vice-president and secretary. They propose, in addition to the specialties they are now producing, to manufacture a line of turret lathes of new design, and embodying a number of the patented features contained in the motor gear lathe recently put on the market by the Ohio Machine Tool Company. In addition to the above, the Lodge & Shipley Machine Tool Co. will manufacture a complete line of machinery for boring and turning pulleys, couplings, friction clutches, etc., from twenty inches to six feet in diameter.

The Niagara Falls tunnel will probably be finished October 1, and the wheel-pit excavation shortly after. Power will begin to be furnished toward the end of March, at latest, possibly in January, and at two points: 1. The central station, where about 10,000 horse-power will be turned out from three 5,000 horse-power wheels, which will probably be converted into electricity and distributed. By enlarging the wheel-pit ten 5,000 horse-power wheels can be put at this point. 2 About 3,000 horse-power for the Niagara Falls Paper Co., which is furnished at the extremely low price of $8 per year per 24-hour horse-power, we understand. The company's public announcements of rates for power are $10 per horse-power for 5,000 horse-power or over; $10.50 for 4,500 horse-power; $11 for 4,000 horse-power and so on down to $21 for 300 horse-power, all for 24-hour power if wanted, the cost of ordinary steam power for a 10-hour day ranging from $25 to $40. There will be seen to be a large margin, therefore, even from the higher rates for the water-power. The ultimate capacity of the tunnel is some 100,000 horse-power of 24-hour power.—*Eastern Controller.*

Machinists' Supplies and Iron.

NEW YORK, September 3, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14.50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $14.25 to $15 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.75 to $13.50 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Antimony—The market is dull and easy. We quote L. X., 11½c. to 11¾c.; Cookson's, 12¼c. to 12½c.; Hallett's, 10½c. to 10⅝c.

Copper—The market is quiet, and quotations are nominal. Lake Copper is quoted at 10.50c. to 10.60c. Casting Copper is held at 10⅝c. to 11c.

Lead—A stronger feeling prevails. Sales of 200 tons have been made at 4⅛c. to 4.15c. Holders now ask 4.20c.

Lard Oil—Prime City is quoted at 62c. to 63c.; Western on spot at 61c.

Spelter—The market is quiet. Holders are quoting 4.70c. in a nominal way.

Tin—The market is changeable. During the beginning of the week 75 tons changed hands at 20.60c. for October, November and December delivery; and at a later date sales have been made at 20.25c. to 20.35c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Position by exp'd draftsman, N. Y. City; references furnished. BOX 73, AM. MACHINIST.

Wanted—Agents in every shop for machinists' fine tools, sliding calipers, etc. E.G.Smith,Columbia, Pa.

Wanted—Position as foreman boiler maker; reference furnished. Foreman, AM. MACHINIST.

Wanted—Two or three first-class machinists at once. Gisholt Machine Co., Madison, Wis.

Assistant mechanical draftsman of 5 years' experience desires situation. BOX 77, AM. MACHINIST.

Position wanted by graduate of Cornell University as draftsman; 2 years' machine shop experience. Address S. C., AMERICAN MACHINIST.

First-class mechanical draftsman and designer desires to make a change. Address Reliable, 27, AMERICAN MACHINIST.

Wanted—Position by designer of hydraulic machinery and tools; 8 years draftsman, 8 machinist and tool maker. BOX 68, AMERICAN MACHINIST.

Wanted—By man long experienced in general machinery business, position in charge New York office of a Mfg. Co. Engineer, AM. MACHINIST.

Wanted—Three planer hands, 3 lathe hands, and 2 floor hands, all first-class men. Sioux City Engine Works, Sioux City, Iowa.

Wanted—In a foundry making cotton machinery castings, a foreman; give age, exp., refs., nationality, and pay expected. X., AMERICAN MACHINIST.

Wanted—A pattern maker on cotton machinery work; must be thoroughly acquainted with foundry practice; state age, experience, nationality, and pay expected. Address Y., AMERICAN MACHINIST.

Wanted—A young man as draftsman; one able to make good tracings, and to work from sketches. Address, stating age, experience, and salary expected, Box 75, AMERICAN MACHINIST.

First-class mechanical draftsman (graduate Sweden, age 24), with 4 years' exp. in this country, thoroughly competent in eng and pump designing, desires engagement. Box 67, AMERICAN MACHINIST.

Wanted—A capable and practical machinist, one having experience on machine tool work. A good opportunity for a thoroughly reliable and competent man. Address BOX 70, AMERICAN MACHINIST.

Draftsman.—A machinist with technical training, and 8 years' drafting and designing experience, desires a situation; steam engines or cranes preferred. Address Age 34, care AM. MACHINIST.

Wanted—Foreman for machine shop employing about fifty hands; a thorough machinist, and one capable of handling men required. Address P. O. Lock Box 32, Waterbury, Conn.

Wanted—By a graduate of Stevens Institute, who has held a similar position—to which he refers—a position as superintendent or general manager with a mfg. concern; refs. Box 76, AM. MACHINIST.

Wanted—1st-class man, successful in managing men, and thoroughly acquainted with screw machine work, to take superintendence of a machine screw factory in Western city. Address Queen City, AMERICAN MACHINIST.

An energetic and progressive young man (30), with a general machinery firm 12 years, both in the works and offices, and competent to conduct the office department of a manufacturing concern, desires a similar position, or some other of trust; references of the highest character. Address J. C. Reynolds, Box 5, 165 Fulton Street, New York.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d-hd lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Presses, Wire Form'g Mchy. Am. Tool Wks, Clev, O.

Bolt Cutter Heads a Spec'y. Am. Tool Wks., Clev., O.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

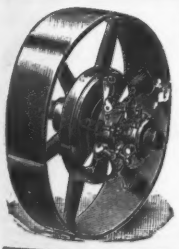
Designs perfected; drawings, patterns and machines made to order. S. Carey, 17 Broadway, N. Y.

Bradley Hammers.

If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.

BRADLEY & COMPANY, SYRACUSE, N. Y.

STEAM BOILERS,
THEIR CONSTRUCTION, STRENGTH AND ECONOMICAL WORKING.
BY ROBERT WILSON AND J. J. FLATHER.
"The Standard for Practical Men."
108 Illustrations, Tables, etc., 12 mo. Cloth, $2.50.
JOHN WILEY & SONS,
53 East Tenth Street, New York.



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15th St. & Lehigh Ave.,
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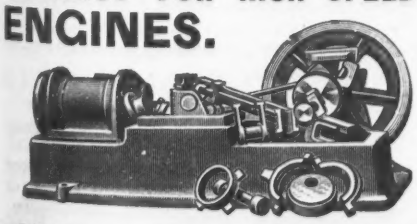
Friction Clutches
AND
Cut-off Couplings.
Send for Circulars.

CASTINGS FOR HIGH SPEED ENGINES.



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333 E. 56TH ST. NEW YORK.

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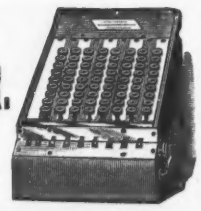
SPECIAL MACHINERY. PRICES on APPLICATION

BARDONS & OLIVER Cleveland, Ohio.

SCREW MACHINES.

COMPTOMETER.



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60% of time in doing the work.
And all the time looking for errors.

Solves with great rapidity and absolute accuracy all arithmetical problems.

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FELT & TARRANT MFG. CO.
52-56 Illinois Street, CHICAGO, ILL.

ASHLEY ENGINEERING CO.,
MANUFACTURERS OF
STEAM SPECIALTIES.
136 Liberty St., New York.

Having completed our New Works at Hawthorne, N. J., and equipped same with New and Improved Machinery, we are prepared to take contracts for manufacturing STEAM SPECIALTIES and

SPECIAL MACHINERY.

VANDERBEEK'S
NEW COUNTERSHAFTS.
NEW CONSTRUCTION,
NEW FRICTION AND SELF-OILING THROUGHOUT.
THE STATES MACHINE CO.,
HARTFORD, CONN.

THE McNAULL UNIVERSAL RADIAL DRILLS.

Newest and best in the market. Furnished in five sizes, from a wall to a 10-ft. swing. Send for circulars.

McNaull Mach. & Fdy. CO
RONCEVERTE, W. Va.

HACKNEY HAMMERS

Meet all requirements more fully and satisfactorily than any other of its competitors.
INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.
WRITE FOR CATALOGUE TO
THE HACKNEY HAMMER CO.,
20 Johnson St., CLEVELAND, O.

STEEL TUBES
WELDLESS
SMOOTH · COLD DRAWN
John S. Leng's Son & Co. New York.

WANTED

to dispose of the patents of Mauser's patent Surface Gauge illustrated in this issue of the AMERICAN MACHINIST, or will arrange for its manufacture on royalty.

A. MAUSER,
54 BUCKINGHAM ST., HARTFORD, CT.

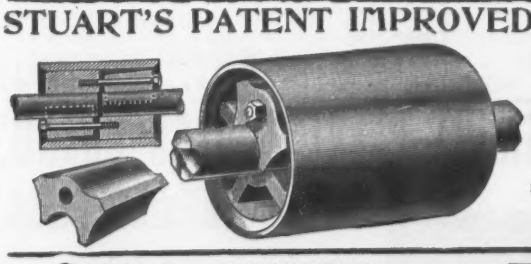
SWIVEL BASE.
4 OFFSET JAW VISE.

Specially adapted for drill press work where chucks cannot be used, and equally good for special or regular bench work.
Send for catalogue of full line of the most improved designed, and best finished machinists', plumbers', coach makers' and pattern makers' vises and small tools.

HOLLANDS MFG. CO.,
ERIE, PA.

JAMES P. WITHEROW'S
Engineering Works and Stock on Hand,
NEW CASTLE, PA.,
Will be sold at public sale, Saturday, September 10th, 1892, at 10 o'clock A. M., on the premises.
For particulars apply to
ALEXANDER THOMAS, Assignee,
PITTSBURGH, PA.

STUART'S PATENT IMPROVED WEDGE COUPLING.



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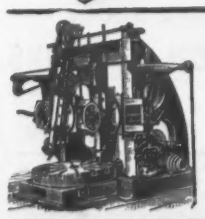
SENT ON TRIAL.
Can be attached or removed in a few seconds without injury to shaft or coupling.
SIMPLEST and BEST in MARKET, Also the Cheapest.
Send for discounts and illustrated Price List of 20 sizes.
ROBERT J. STUART,
NEW HAMBURGH, N. Y.



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14 SIZES—FROM 5 TO 20 FEET.
BETTS MACHINE COMPANY,
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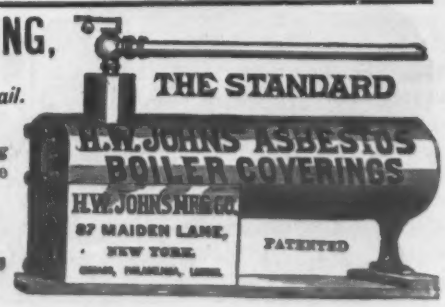
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.



✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 85 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J

Design & superintendence of mach'y. Drawings, etc., made. Claud Mantle, 598 E. 134th St., N. Y.

Wanted—A specialty to manufacture either heavy or light work. We have splendid facilities. Address "Manufacturers," Rockford, Ill.

For Sale—Half interest in a machinery business, established in Boston twenty-two years; this is a chance of a lifetime. Lock Box 5, Roxbury, Mass

For Sale—A well-located shop down town New York, suitable for brass and light machine work. J. Jones & Son, 39 Vesey Street, New York.

Agency wanted—A young, energetic mechanical engineer wants to represent some good firms for Buffalo and surroundings. Box 44, care AM. MACH.

Wanted—Hardware specialties to build. Send 2c cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 327 Eddy Street, Providence, R. I

For Sale—All the machinery and fixtures of a machine shop and foundry situated at Whitesboro, N. Y. Lists sent on application to B. T. Babbitt, New York City.

Wanted—To rent, or would run by the ton a foundry that will give steady employment to ten men, making light machinery. D. F. Slade, Worcester, N. Y.

Bound volumes for 1891. We are now prepared to take orders. Price, $4.00 per volume; express charges payable by purchaser. Address AMERICAN MACHINIST, 203 Broadway, New York.

We will pay 25 cents each for copies of the AMERICAN MACHINIST of December 25, 1886, issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Special, experimental or other light machinery manufactured. Best equipped shop in the West for fine work. Manufacture one of the best hollow spindle bench lathes for the tool room or for manufacturing. Write us. Moseley & Co., Elgin, Ill.

The undersigned have decided to confine themselves exclusively to the manufacture of their automatic engine, and offer their patterns and general jobbing trade for sale; jobbing trade amounted to $93,000 the last twelve months; a splendid chance for a good mechanic to start in with a permanent and good paying trade. Address J. H. McEwen Mfg. Co., Ridgway, Pa.

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LATHES.

All sizes of FLATHER.
" " BLAISDELL.
" " FIFIELD.
One each, 14"x6' and 24"x12' FITCHBURG.
One 78"x15' SELLERS.

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All sizes of WHITCOMB.
" " FLATHER.
One each, 30"x8' and 36"x8' PEASE.

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All sizes of PRENTICE.
" " BLAISDELL.
One 5' CINCINNATI RADIAL.
One 8" NEWTON SLOTTER.
All sizes of HENDEY and GOULD SHAPERS.

WRITE FOR PRICES.

HILL, CLARKE & CO.,

156 OLIVER ST., BOSTON, MASS.
CHICAGO BRANCH, 12 and 14 South Canal Street.

FOR SALE.

THE FOLLOWING LIST OF

Second-Hand Machinery in Stock,

MODERN STYLE, in first-class running order, WILL BE SOLD LOW.

Lathe, 66 in. swing, 24 ft. bed, powerfully geared, very heavy, with screw feed, extra slotted tables for boring, boring bars and shaft. Suitable for boring and facing large cylinders, facing columns, etc.
Special Lathe, 60 in. swing, for boring, turning and facing; has two tools, boring attachment, facing attachment for 60 in. work, and complete with 42 in. chuck. Used six months. A1 order.
Key-seating Machine, for large and small wheels, can be used as a portable or stationary.
Fitchburg Shaper, 14 in. stroke, traveling head with vise, latest pattern. Used six months. A1 order.
Slotting Machine, 8 in. stroke, with automatic cross, side and circular feed. A1 order.
Lathe & Morse Planer, 24 in. x 8 ft., late pattern. A1 order.
Jones & Lamson No. 11 Screw Machine, with 2¼ in. hole, clutch gears, chasing bar, automatic feed on turret, complete with chucks and tools. A1 order.
Boiler Bending Rolls, improved style, 8 and 10 ft.
Riveting Machine, 60 in. gap, for boiler and bridge work, complete overhead hoisting rig, with cross and side movements, and large assortment of dies in good order.
Large stock of Lathes, Planers, Shapers, Drills, etc., both new and second-hand.

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SUCCESSOR TO E. P. BULLARD'S N.Y. Mach'y Warerooms, 68 Cortlandt Street, NEW YORK.

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10 ft. x 10 ft. x 16 ft. Planer.	1 Head.		
72 in. x 48 x 30 ft.	3 Heads.		
72 in. x 48 ft. x 24 ft.	do	3 Heads, Detrick & Harvey, new.	
62 in. x 48 in. x 17 ft.	do	1 do	
54 in. x 42 in. x 24½ ft.	do	2 do	
46 in. x 33 in. x 30 ft.	do	2 do	
39 in. x 36 in. x 12 ft.	do	1 do	
36 in. x 38 in. x 8 ft.	do	Powell A1.	
30 in. x 30 in. x 7 & 8 ft.	do	1 Head.	
26 in. x 26 in. x 6 ft.	do	1 do	
25 in. x 24 in. x 6 ft.	do	1 do	
22 in. x 21 in. x 5 ft.	do	1 do	
50 in. x 30 ft. Bed Triple Geared.		New Engine Lathe.	
48 in. x 22 ft.	do	do do do	
42 in. x 17 ft.	do	A1 do do	
36 in. x 24½ ft.		New Haven do do	
30 in. x 28 ft.		D. W. Pond Shafting Lathe	
26 in. x 25 ft.		D. W. Pond Engine do	
32 in. x 12, 14, 16, 18 ft. Bed.		New do do	
28 in. x 12, 14, 16, 18 ft.	do	do do do	
21 in. x 10, 12 ft.	do	do do do	
20 in. x 7½ & 8 ft.	do	2d Hand do do	
18 in. x 6, 7 & 8 ft.	do	New & do do do	
17 in. x 8 ft.	do	do do do	
16 in. x 6 & 8 ft.	do	do do do	
15 in. x 6 & 8 ft.	do	do do do	
14 in. x 6 ft.	do	do do do	

Car Axle Lathe, Bement.
9 & 12 in. Stroke Slotters.
15, 16, 18, 25 in. Crank Shapers.
20, 24, 26 & 30 in. Geared Shapers.
20, 22 24, 28, 30 & 36 in. Drills.
Bolt Cutters.
2 Garvin No. 4 Millers, A1.
1 Brainerd No. 3 Miller, A1.
No. 5 Stiles Press, Geared, A1.

GEO. PLACE MACHINE CO.,
120 BROADWAY, NEW YORK.

LOOK AT THESE BARGAINS IN SECOND-HAND MACHINERY.

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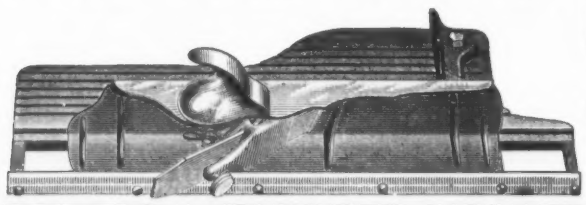

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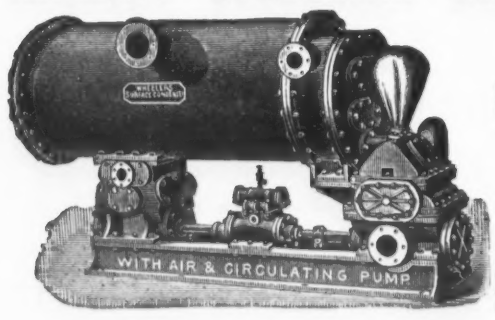

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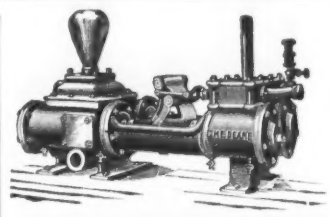

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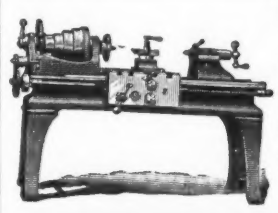

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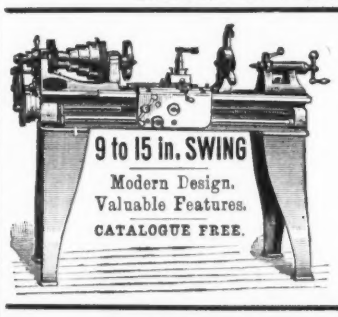

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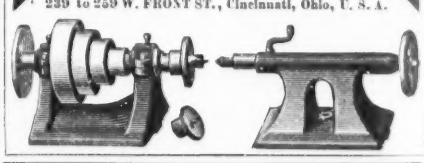

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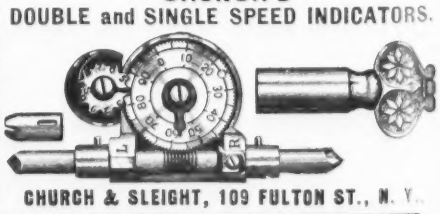

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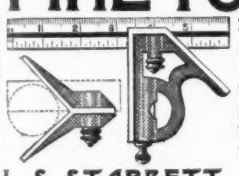

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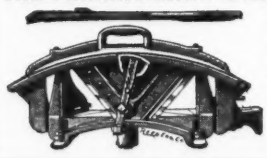

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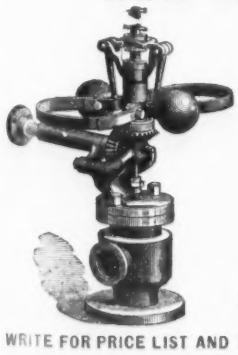

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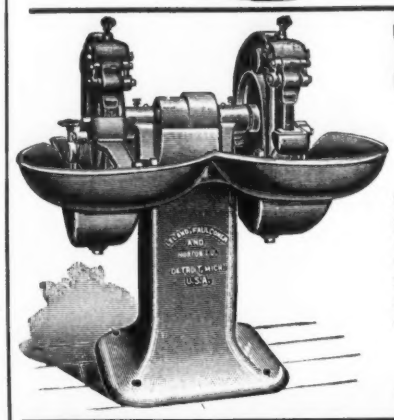

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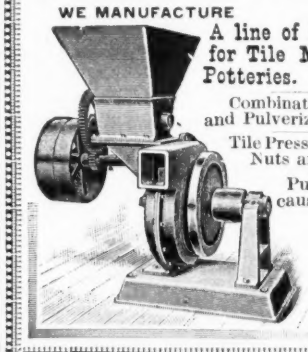

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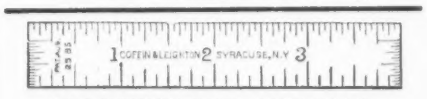

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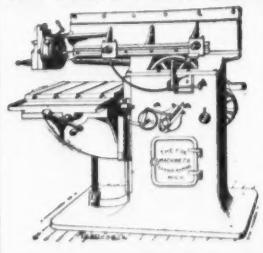

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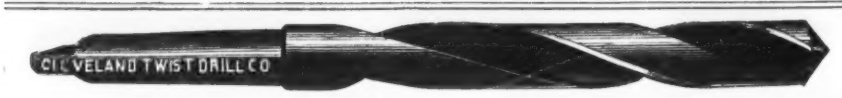

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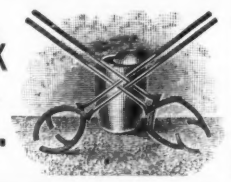

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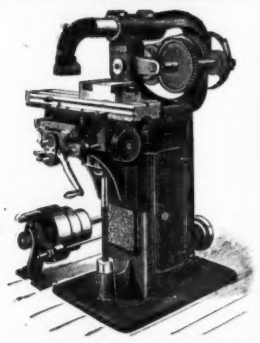

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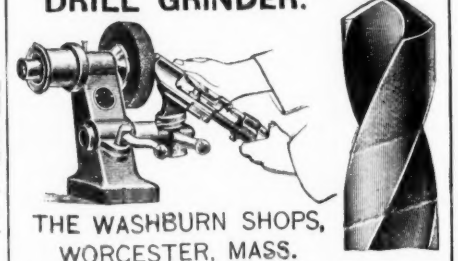

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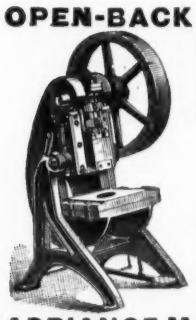

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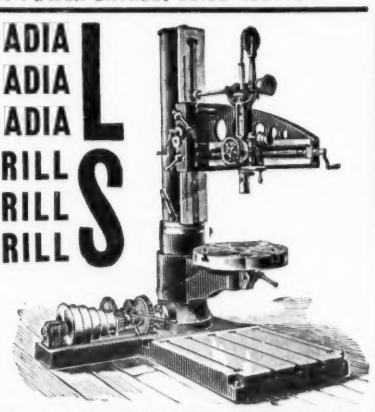

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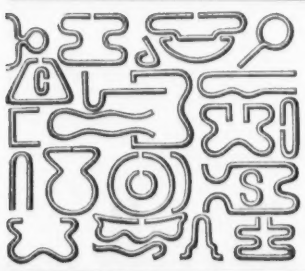

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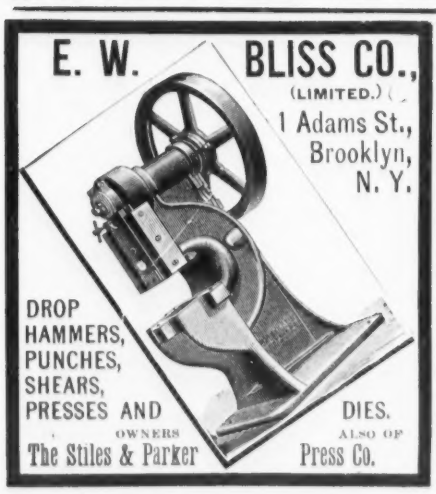

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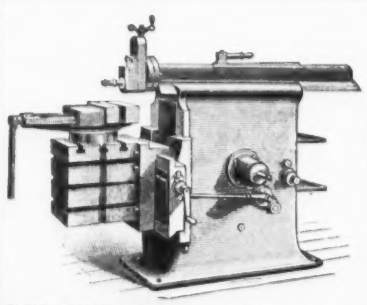

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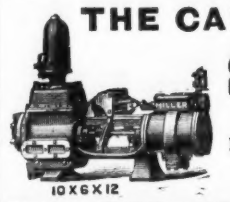

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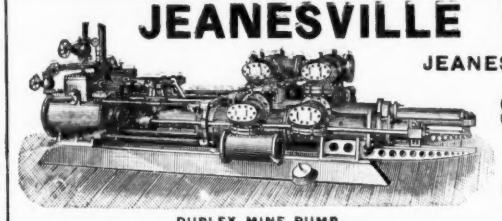

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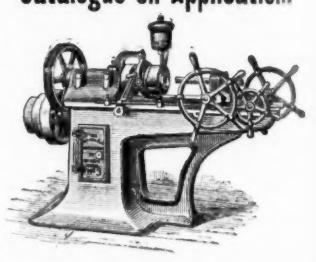

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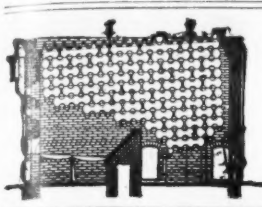

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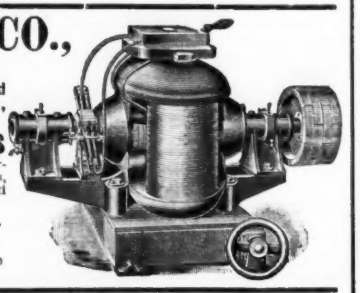

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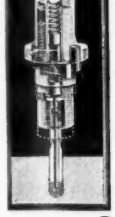

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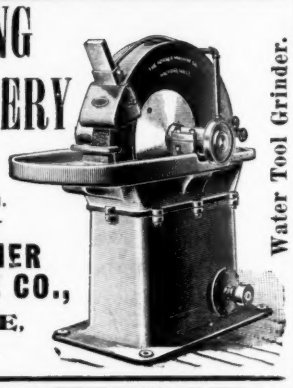

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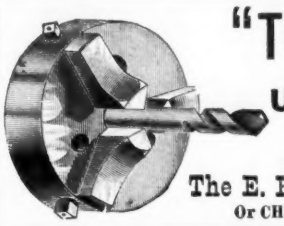

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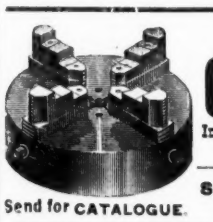

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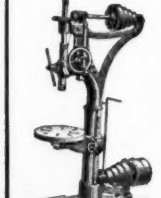

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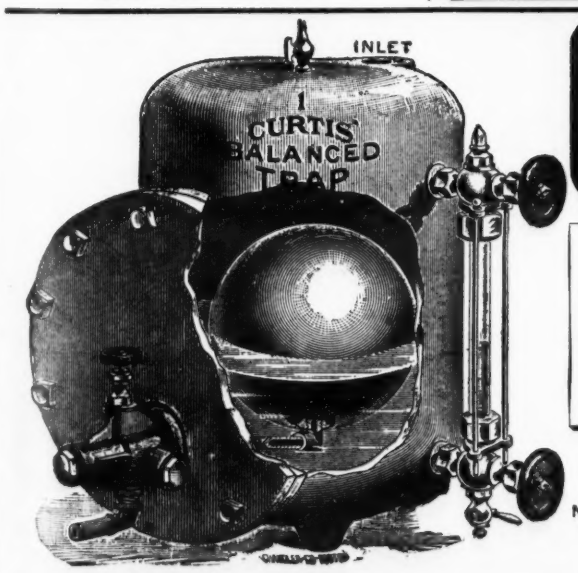

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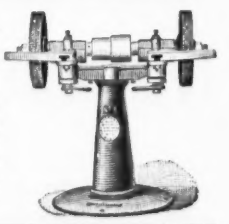

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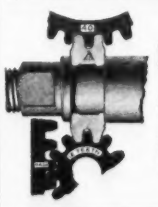

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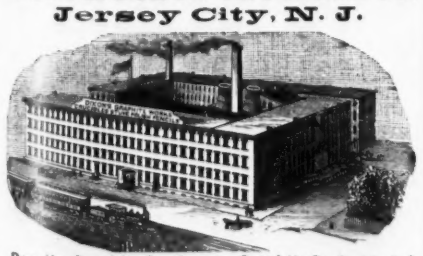

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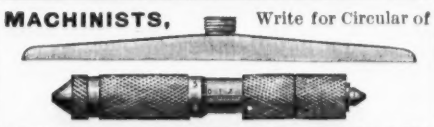

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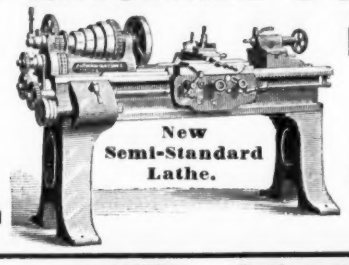

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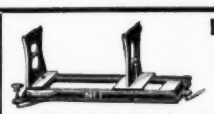

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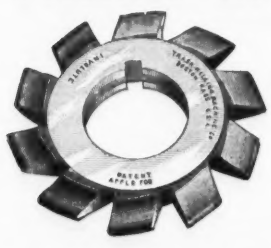

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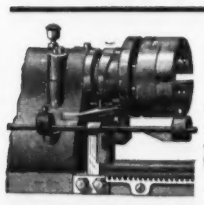

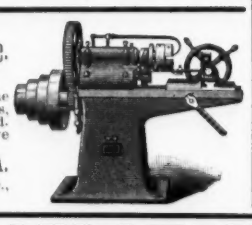

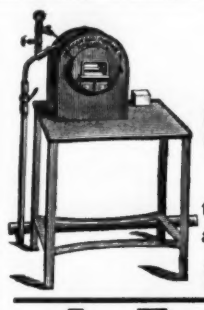

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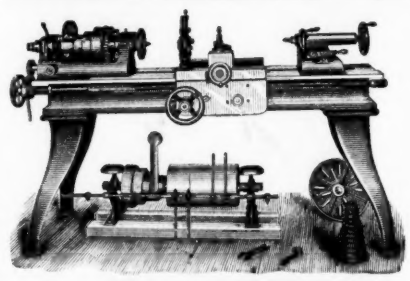

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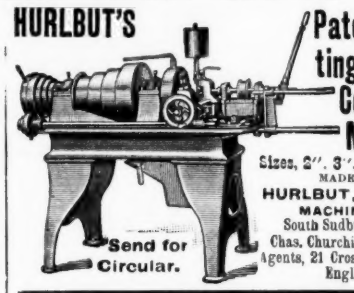

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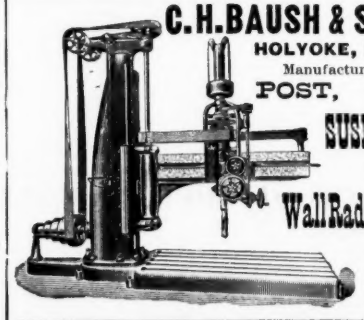

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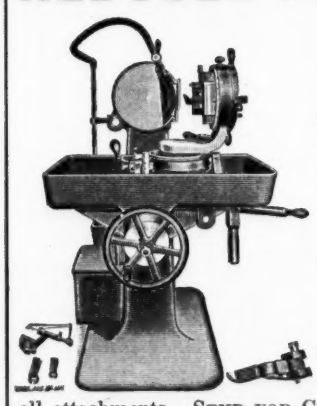

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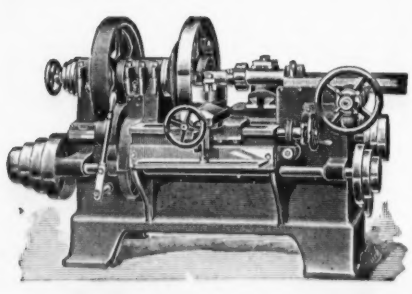

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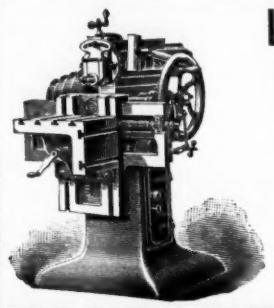

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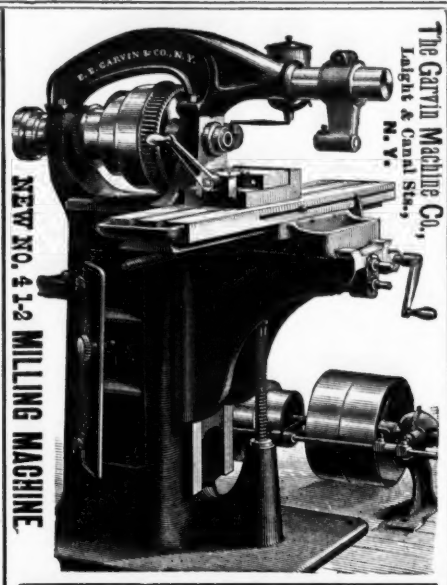

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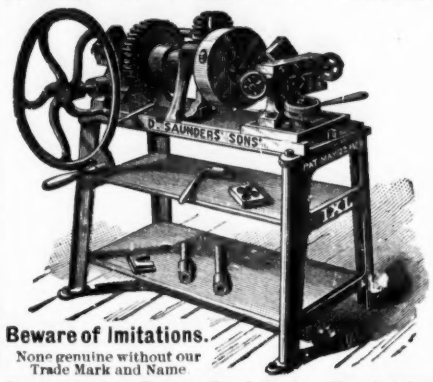

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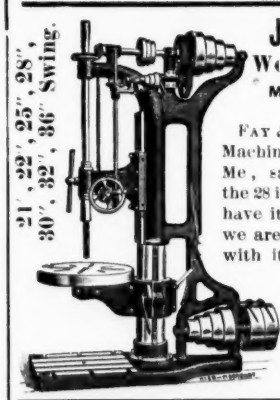

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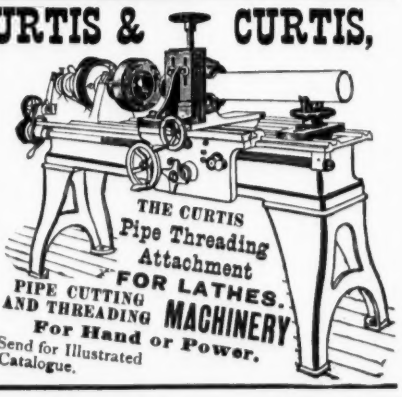

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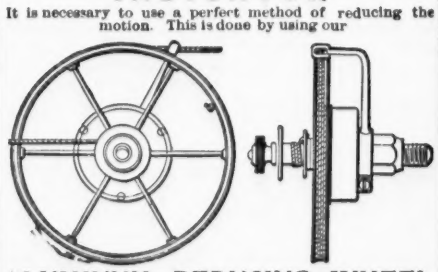

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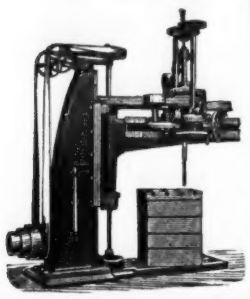

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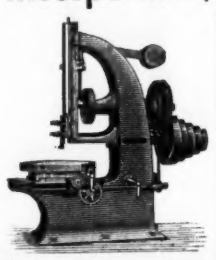

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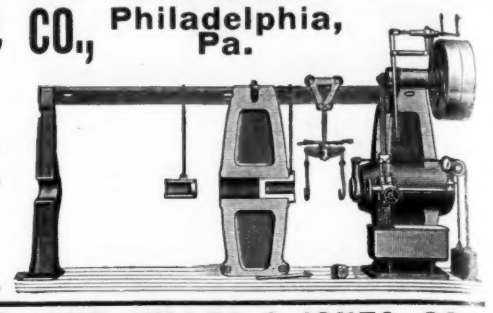

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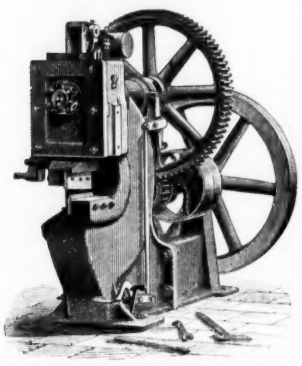

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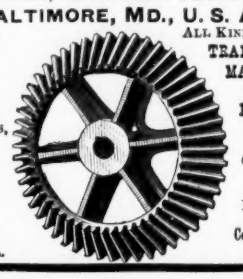

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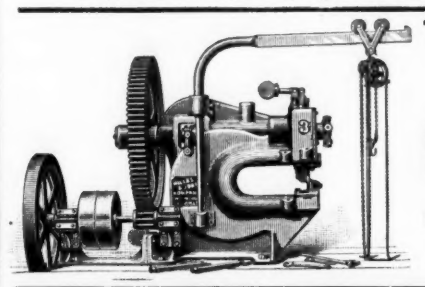

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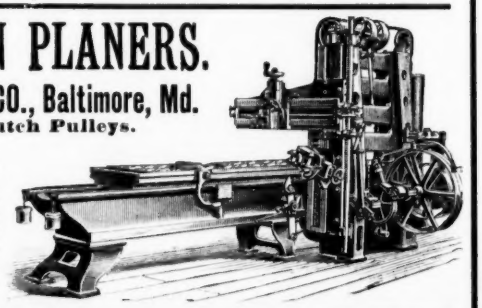

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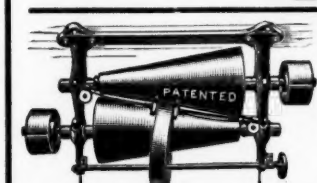

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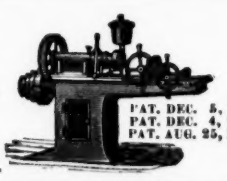

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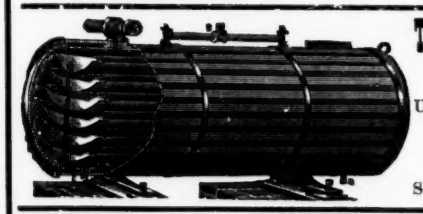

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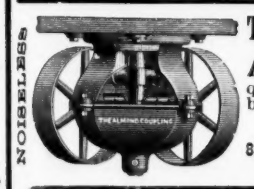

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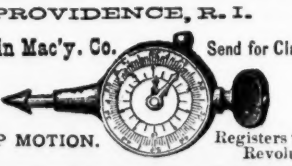

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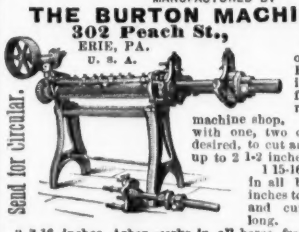

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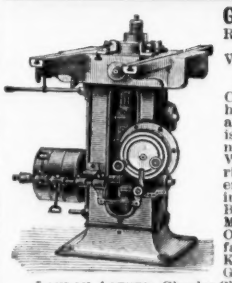

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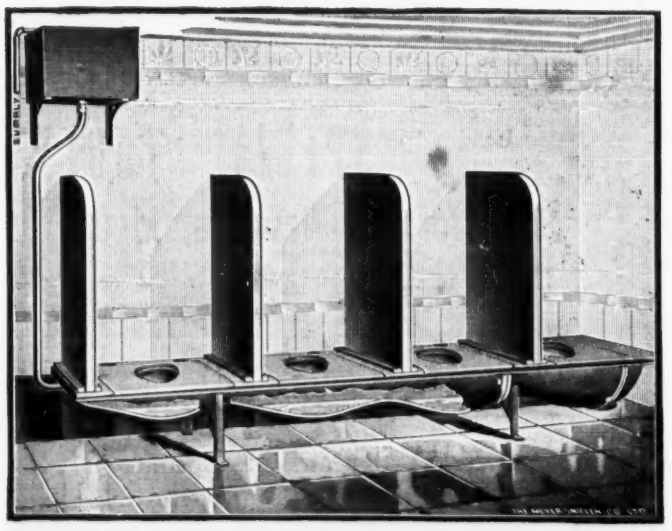

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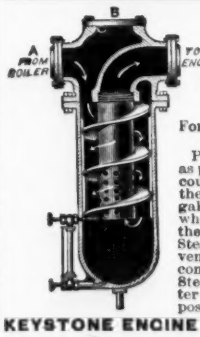

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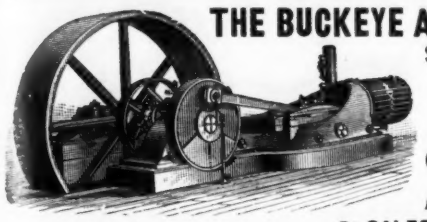

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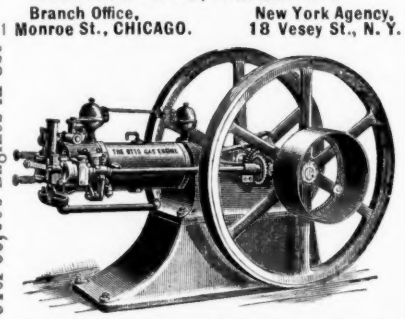

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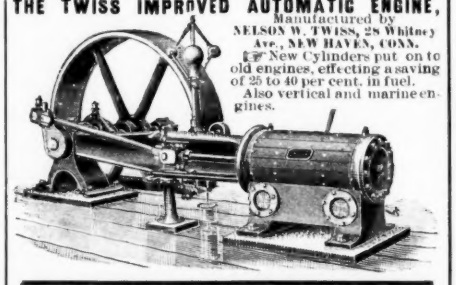

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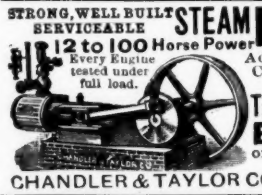

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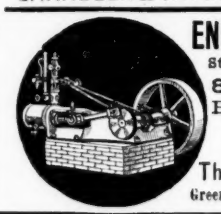

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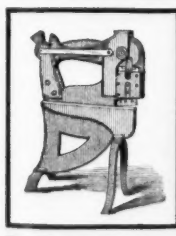

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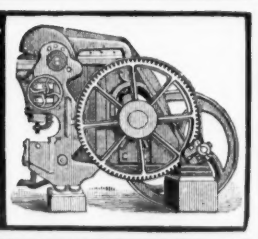

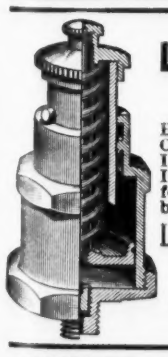

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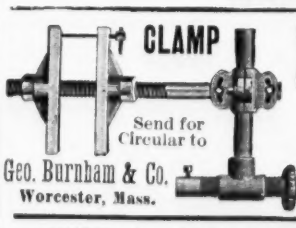

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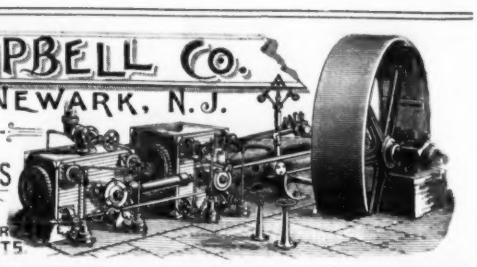

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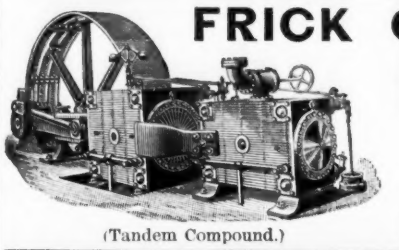

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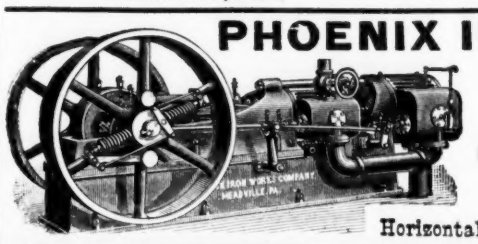

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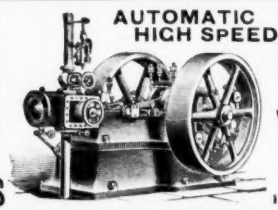

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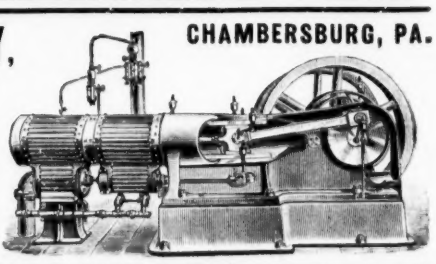

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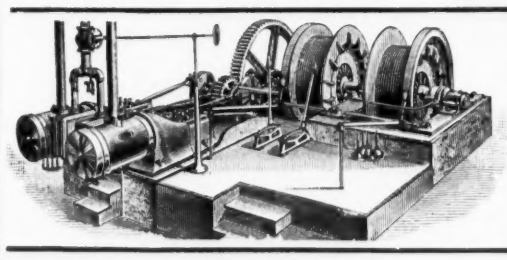

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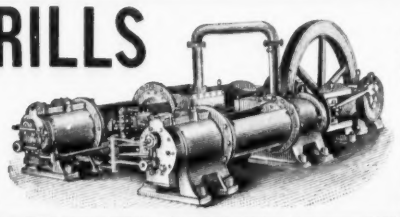

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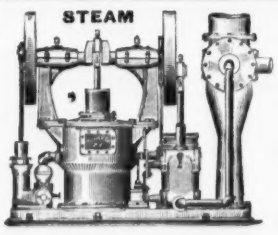

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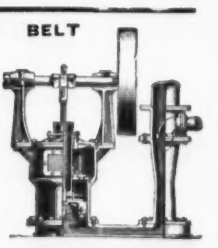

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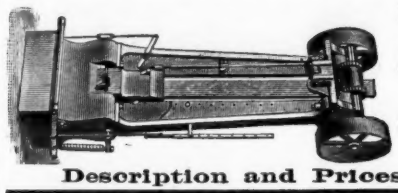

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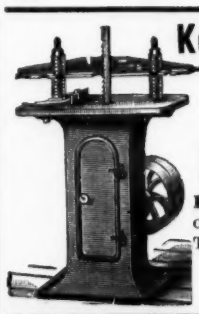

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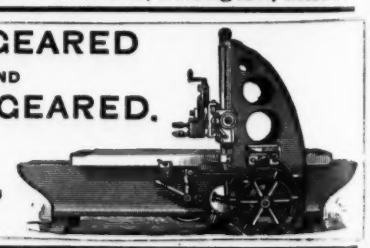

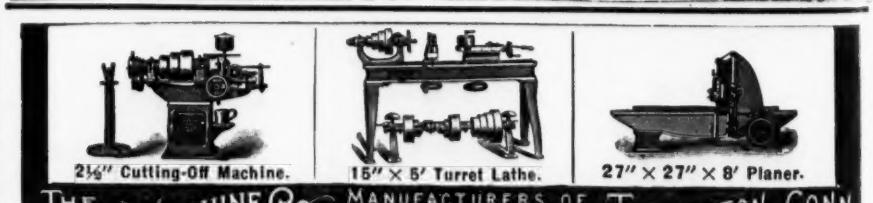

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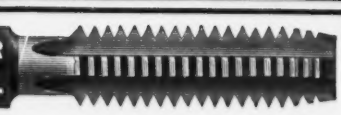

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